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THE N. E. L. A. CONVENTION.

In a supplement to this issue are given abstracts of the remarkably full programme of papers read at the Convention of the National Electric Light Association held at Cincinnati this week, and also a condensed account of the proceedings. Owing to the holding of three sessions daily, the stenographic report of the meeting has been delayed, but the salient points of the discussion which occurred will be given in full in following issues, when also the more important subjects considered will receive editorial notice. One is safe in saying that the Cincinnati Convention has been the most successful in the history of the association, if it be judged only by the programme of papers. The merely perfunctory and commercial paper is conspicuous by its absence, and those to whom fell the task of selecting subjects and the writers, deserve the highest commendation for the excellent judgment displayed. With scarcely an exception, the papers treated of topics uppermost in the minds of central station men. The contributions on the subject of rates, free lamp renewals and long-distance transmission lines in particular form a contribution to the literature of these subjects of the utmost value. To President Doherty and his associates we extend our congratulations on the gratifying result of their intelligent labor.

THE BUCKINGHAM TELEGRAPH PRINTER.

Few electrical inventions in these days have reached a point of practical utility with less of heralding than the Buckingham page printing telegraph system, which Mr. Maver describes in an article this week. The art of printing telegraphy is not a new one by any means; but, almost without exception, prior to Mr. Buckingham's work along this line, no great practical success had been reached in the attempts to produce a printing telegraph system operative at a high rate of speed on the longest circuits, and in which the messages would be printed as received on the ordinary telegraph blank. Hitherto, the commercially operated printing telegraph systems, like the Hughes, the Phelps and Baudot, have printed the received message on a continuous line on a paper tape, practically similar to that of the well-known "ticker" tape. It is of public knowledge that the large users of the telegraph in this country strenuously object to having telegrams delivered to them in this form, and to meet this objection the expedient of cutting up the strip in line lengths and pasting it on the telegraph blank has sometimes been resorted to, but not with marked success. It may be said, further, that the ordinary business man is to-day quite as averse to receiving telegrams in the operator's hand-writing, as he is to receive or transmit his ordinary correspondence in that shape, a fact which the telegraph companies have fully appreciated, and which they have endeavored to meet by encouraging the use of the typewriter by their operators.

These facts have doubtless contributed materially to the gradual disuse of such systems as the Phelps printing telegraph in this country, and have rendered it imperative that any improvement in the speed of printing telegraph systems must be accompanied by the reproduction of the transmitted message in typewritten page form. The system which Mr. Buckingham has evolved appears to meet this requirement in a simple and successful manner. The method of transmission employed in the Buckingham system is practically similar to that of the Wheatstone automatic telegraph, namely, the double or reversed current method, this having been found best adapted to rapid signalling on long lines. A speed of 200 messages per hour on one circuit between New York and Chicago, which is

attained by the Buckingham printer, is of greater importance than might at first appear, when it is considered that a circuit of similar length operated as a Morse duplex probably does not carry over 60 average messages per hour. The advantages that such a printing system possesses over the Wheatstone or chemical automatic system is obvious when we consider that while the former prints the message for delivery simultaneously with its reception, the tape of the latter must first be translated and typewritten. Another merit of this latter system is that any errors can be detected and corrected almost immediately, while errors on the Wheatstone or chemical systems are not usually detected until the tape reaches the copyist, thus frequently delaying the translation and delivery of the messages.

MANUAL VS. MACHINE TELEGRAPHY.

In another column we print a letter from Mr. J. C. Barclay, electrical engineer of the Western Union Telegraph Company, in which issue is taken with those who would accuse the Western Union of being wedded to antiquated telegraphic methods. As one who is an acknowledged master of the art of telegraphy, from the key to the broad problems involved in a great system handling 66,000,000 messages annually through 23,000 offices, Mr. Barclay is ideally fitted to speak on the subject. His unqualified verdict in favor of manual over automatic telegraphy, except for emergency service, is entitled, therefore, to the highest respect, even though it may appear to be at variance with the great modern tendency to replace as far as possible the manual operative by the machine. It may be answered, however, that the comparison which weighs so strongly against automatic or machine telegraphy is based upon conditions of service which favor manual telegraphy and militate against its modern rival. In other words, the conditions of telegraphy to-day differ little from those of 50 years ago—it remains an urgency service, at least during day hours. If one wishes to send a message at one hour that may as well be delivered some hours later, the message is in theory—if not in practice—on the same footing as one which demands the most rapid haste. As a consequence of this lack of differentiation, an office must be organized to dispose of all business promptly as received, and it is contended that such an organization implies manual telegraphy. But many will, we believe, agree with us in the opinion that if the telegraph service of this country were to be reorganized by the partisans of automatic telegraphy, with power to proceed untrammeled by the traditions of the past, they would by no means meet with the overwhelming defeat that partisans of the old system might consider inevitable. Or, to state the case in another manner, if the birth of telegraphy had been delayed 40 or 50 years, one does not venture much in saying that its evolution would be along entirely different lines than in the past—and, furthermore, that these lines would be fixed by the exigencies of automatic or machine telegraphy.

THE SYNCHRONOUS MOTOR.

In his article on synchronous motor calculation, printed in last week's issue, Mr. F. G. Baum has done practical men a particularly good turn. The average electrician who has to deal with synchronous motors in his daily work is likely to be rusty, to put it midly, on the algebra of complex quantities, and yet he wants to solve ordinary problems in synchronous motor working rather frequently. To those who find themselves in such a position graphical methods appeal strongly. They permit of rapid approximate solutions of many rather difficult problems, and often have the additional advantage that their constructions lead, for particular values of the quantities concerned, to rather easy attainment of rigorous results by the aid of plane trigonometry alone. Mr. Baum's diagrams and equations enable the ordinary computations of synchronous motor practice to be performed with celerity and ample accuracy for practical quantities. In the purely mathematical discussion of these matters, one often forgets a very essential qualifications that separate rigorous theory from ordinary practice. We refer to the general fact that in the every-day problems of power transmission the quantities usually assumed as constants are really variables which cannot be expressed as linear or even quadratic functions of anything whatever.

For example, cos ϕ, one of the commonest factors in ordinary computations regarding alternating currents, is in any practical plant a variable of the most annoying character. One can obtain by exact computation a series of results which will be true of particular instantaneous values of the power factor, but broadly it cannot be regarded as physically constant within five per cent. or so for any ordinary period of time. Consequently, the precision of ordinary graphical methods is amply sufficient to represent the facts. In figuring the over-excitation proper for a synchronous motor, for example, the best that can be done is to approximate it for an average condition, and this can be done, as Mr. Baum has shown, with great facility. The value of simplified methods—short-cuts, as it were—to the busy man is very great, and the more of them one has at his finger tips the better. All that one asks is that the methods should lead to results of the same order of precision as the available data. If the methods are exact, it is so much clear gain, but there is such a thing as putting a hundred-dollar harness on a ten-dollar horse. Of course, one can overdo graphical methods, just as one can torture algebra into doing work fit only for the calculus; but Mr. Baum has kept well clear of intricate and troublesome constructions, and has managed to put a subject, generally considered altogether troublesome, into a very straightforward and practical form.

THUNDERSTORMS IN THE UNITED STATES.

The annual report of the Weather Bureau for 1901 contains, as usual, some very interesting information and data. When it is remembered that about 1,500 skilled observers and nearly 200 stations have contributed to the collection of the observations from which the data are compiled, it is no wonder that the results are of interest. In this report the number of days in which thunderstorms were reported in 1901 are tabulated with respect to the particular Weather Bureau stations and the months of the year. In frequency of recurrence at individual stations, Florida leads with 70 thunderstorm days in the year, a frequency which finds an equal only in the mountain districts of Georgia and the Carolinas. The frequency diminishes in all directions from Florida, if this mountain region be omitted, and becomes reduced to about ten days per annum near Nova Scotia, and about four days per annum on the sea level of the Pacific coast. The average for the entire United States is about 30.4, of which rather more than one-half occur in the three months, June, July and August.

The number of thunderstorm days per year follow, in a general way, the annual rainfall. That is to say, in Florida, Georgia and the Carolinas, where the annual rainfall is heaviest, the thunderstorms recorded at individual stations are also most frequent; and as a very rough rule, one thunderstorm accompanies each inch of rainfall. Notable exceptions to the rule occur, however, in more northern latitudes—namely, toward Nova Scotia on the Atlantic, and toward Vancouver on the Pacific, where the rainfall apears to accumulate without concomitant thunderstorms. It may be, perhaps, that in sunny climes rain and atmospheric electrical disturbances go hand in hand; whereas in more temperate regions the rain falls without marked atmospheric electrical disturbance. As regards danger to electric transmission lines from atmospheric electricity, this is sometimes found in mountainous regions in the absence of thunderstorms. In Colorado, for example, it is frequently reported that atmospheric discharges through transmission lines occur with a clear sky.

Powerful atmospheric electrical displays are reported to have recently been manifested over the active volcanoes of the West India Islands, and similar phenomena have been reported in connection with volcanic eruptions in the past. It seems likely that the principle of the development of the electric energy in these cases is the friction between the rapidly uprushing matter and the walls of the crater or eruptive shaft. In other words, it seems likely that the principle of operation is that of the hydro-electric machine, in which the friction of gaseous steam passing through a nozzle or jet gives rise to powerful electric phenomena. Moreover, wherever the cloud of upheaved gas over the volcanoe undergoes condensation of any kind, by coming into contact with the relatively cold surrounding air, electric accumulation of potential is to be expected. With spherical particles charged to a given initial voltage, the capacity is as their radius. When these particles coalesce by condensation or aggregation, still remaining spherical for simplicity of conception, the charge increases with the mass of the resulting particles or degree of aggregation, while the capacity increases only as the radius or cube root of the mass. Since the potential is equal to the charge divided by the capacity, the potential must rise as the square of the mass, or of the degree of aggregation. Thus, when the initial particles, charged to say 1,000 volts, are welded, or aggregated by close condensation, into masses of ten times the initial radius, the capacity of each mass has increased ten times, the charge one thousand times, and the potential one hundred times, or to 100,000 volts. In this way it is easy to understand how the condensation of feebly potential gaseous particles of steam in the atmosphere may produce drops of rain high in air, of many millions of volts potential; and also that the chilling of the gases belched from the crater of an active volcano may give rise to similar phenomena.

METERS AND METERING.

The electric meter, like the gas meter, has to endure its share of popular obloquy, but it has nevertheless come to be an indispensable part of the equipment of every well ordered station. Contrary to the generally received opinion, meters when in error are much more likely to run too slow than too fast, so that it is the station that should worry rather than the consumer. The introduction of alternating systems of distribution has greatly complicated the metering situation by reason of the difference between the real and the apparent energy; and in spite of all the study which has been given the matter, no adequate solution of the difficulty has as yet been advanced. In a certain way, the matter is allied to the question of capacity charge on systems in general, but it is not necessarily treated in the same manner. The fact is that too much attention has been given to the theory of metering and too little to the practice. The principal desire of the consumer is to get reliable electric light and power and to get it at a low price. He cares not a rap for the philosophy of the matter, so long as his bills are moderate; nor on the other hand, do the stockholders of the electric supply company care much for the methods employed so long as the dividends are regular. Experience has shown that upon the whole all hands are better satisfied by a metering system than by special contracts,, and hence practice has steadily tended toward metering. But experience has not yet shown the best method of defining charges, or even that there is any best method of general applicability. As we have many times pointed out, electric supply is a business which has definite relations with the public as a whole as well as with its consumers as private persons, and hence the ability of a supply company to adopt arbitrary methods of charging is contingent in the last resort upon public toleration.

Broadly, the policy of a standard rate with discounts based on quantity of product used has worked well in most stations of moderate size, particularly in those operating no day or power circuits. But these, once a large majority, are steadily decreasing in number, and with the initiation of power and other day circuits the trouble begins. The particular form which it takes depends on the character of the station, but the fundamental desire of every manager is to make his load curve as nearly a straight line as is possible. All sorts of schemes based upon metering systems or special contracts have been devised to further this end, but the great stumbling block in the way is the fact that most people want electric lights at a particular time of the day, and at no other time. It is of little use to offer a man cut rates for lighting at hours when he does not want it, or to discourage the use of lights at the peak of the load when they are needed. One can make small changes in this way, but not large ones. The thing really effective is to study the local market with the greatest care with a view of developing demands of a favorable kind. The great desideratum is a large use of electricity during the twenty hours between 8 P. M. and 4 P. M., or in large cities between midnight and 4 P. M., and this no mere cut rate scheme seems able to attain. In some isolated cases motor service terminating at 4 P. M. or 5 P. M. might be arranged for, but more than discounts are necessary to prevent the accumulation of a peak. If the storage battery were adroitly applied it would probably do more to steady the load conditions than any other one influence. It makes little practical difference in the results whether discounts for hours outside the peak are made automatically by the meter or semi-automatically by the book-keeper. Even a carefully applied contract system could yield good results in the general way of regulating the load, and taking account when necessary of unusual demands for capacity. Extreme refinements are not necessary for this end.

But alternating apparatus of low power factors presents a different problem. Here is a capacity demand that pulls away at the station all the time and does not tend to even itself up, as the aggregate of casual demands for capacity may. Induction motors or arc lamps with power factors of .7 or less have introduced a new and serious problem into station accounting. Meters which register merely the real energy consumption of such apparatus do not adequately evaluate their demands upon the station, and the question might well be raised whether a recording current meter would not give a fairer basis of charging for this class of service. The propriety of making some charge for the current output actually required hardly admits of debate, whatever view may be taken of the desirability of a capacity charge as such. Ordinary meters, too, make no difference between a customer who runs a small and steady load of fairly good power factor, and a customer who demands the same number of watt-hours monthly at a very bad power factor. In stations of moderate size the manager is frequently able to exercise some control over the character and size of the motors installed on his circuit, and should do so as far as possible; but no one has yet devised any simple and practicable means of dealing with the general problem. A combination of flat rate and meter rate can be successfully applied to motor service, but it is not so easy to work for arcs, which however are less troublesome and do not need so much study of the conditions. Using simple wattmeters, probably the simplest scheme is to base the rates for motor service on a certain assumed power factor so that while the real watts are measured, the apparent watts will upon the average determine the price paid. This is, of course, basing the business on general averages, a procedure which may or may not be philosophically correct, but which is in constant and necessary use in many commercial operations. An electrical supply station is a business enterprise, run for profit and not to demonstrate abstract theories, and so long as it meets public requirements has a wide range of freedom. To our notion, simplicity in its relations with its customers is an important matter, and almost any simple system of charging is better than a complicated one which tempts customers to demand inconvenient modifications.

Pennsylvania Railroad Ends Western Union Contract.

The important announcement is made from the Philadelphia headquarters of the Pennsylvania Railroad that the company had given notice to the Western Union Telegraph Company that the present agreements under which the latter operates lines over the right of way of the railroad would terminate at the end of six months from June 1, 1902. These contracts—one for the lines east of Pittsburg, and the other for those west of Pittsburg—terminated by limitation in September, 1901, and February of the same year, respectively. Provision was made in the contracts for their continuance upon the same terms until they were either renewed or six months' notice was given by either company of its desire to terminate the agreements. The decision to give the required notice was reached by the Pennsylvania Railroad directors at their meeting last week. When the contract for the lines east of Pittsburg expired last September, reports were current that the Pennsylvania would not renew it because of the aggressive move made by the Goulds to enter Pittsburg with the Wabash system.

The notice by the Pennsylvania to sever the contract means that, after almost a year's effort to get the Western Union to make certain concessions, without satisfactory results, the directors had decided to place themselves in the position of using the company's own line or of entering into a contract with some other telegraph company on a more advantageous basis. This would not necessarily exclude the Western Union from entering into a new contract within the next six months, but the action of the directors gave the railroad officials a free hand either to conduct the company's telegraph business themselves or to enter into a contract with some other company. Should the Pennsylvania Railroad determine to embark into the telegraph business on its own account, it would be in a good position to do so. It already has the nucleus of an extended telegraph system along its line. The operation of its train service was conducted entirely over its own lines. Failing to come to terms with the railroad company for a new contract, the Western Union will have to secure rights of way along highways, construct new lines, and secure new buildings for offices. Western Union stock quotations have been very weak on the announcement.

Governmental Supervision and Municipal Ownership in Great Britain.

About a year ago we referred, editorially, to a paper read by Mr. W. L. Madgen before the British Institution of Electrical Engineers, which set forth the manner in which electrical development in Great Britain has been hampered by governmental regulations and municipal obstruction. Following the reading of the paper, the Institution appointed a committee of 16 of its most prominent members, with Mr. Madgen as chairman, to report on what steps should be taken to assist the electrical industry in connection with the matters dealt with in Mr. Madgen's paper.

After eleven meetings, and the hearing of the views of a number of gentlemen, representing various shades of opinion on the subject, the following resolutions have been reported as embodying the views and recommendations of the committee in respect to the matters referred to it:

1. That, notwithstanding that our countrymen have been among the first in inventive genius in electrical science, its development in the United Kingdom is in a backward condition, as compared with other countries, in respect of practical application to the industrial and social requirements of the nation.

2. That the cause of such backwardness is largely due to the conditions under which the electrical industry has been carried on in this country, and especially to the restrictive character of the legislation governing the initiation and development of electric power and traction undertakings, and the powers of obstruction granted to local authorities.

3. That local boundaries have usually no reference whatever to the needs of the community in regard to electric supply and traction; that the selection of suitable areas should be dealt with on the basis of economic principles and industrial demands; and that this has been found to apply also to gas, water, and sanitary engineering.

4. That the development of electric power and traction undertakings offers the most favorable means of relieving congested centers, and of thus contributing towards the settlement of the housing question.

5. That it is expedient in the national interests that the Electric Lighting Acts 1882-8, the Tramways Act 1870, and the Standing Orders relating to special acts for tramways should be amended in so far as they enable local authorities to veto or delay the carrying out of electric supply and traction projects of which the utility can be shown; and that effect should be given to the recommendations of the Joint Select Committee of Parliament 1898 on "Electrical Energy —Generating Stations and Supply."

6. That excessive time is occupied and expense incurred in obtaining authority to carry out electrical undertakings, and that important and growing industries are thereby checked.

7. That while this committee fully recognizes the ability of the technical officials of the Government departments concerned, it is of opinion that the staffs of those departments, as at present existing, are wholly inadequate having regard to the great industrial interests involved; that it is essential that these departments should be put into a position enabling them to keep in touch with all developments in engineering matters, both in this country and abroad, and that a sufficient sum should be provided annually by the Government to enable them to employ and pay a proper staff for such purposes.

8. That the adjustment of departmental regulations to engineering development should not be delayed until the industrial interests concerned are seriously hampered, and that, with a view to preventing any such delay, the Institution of Electrical Engineers should be willing to take part in revising such regulations from time to time.

9. That this committee recommends that the institution should memorialize the Prime Minister to receive a deputation for the purpose of urging the removal of the present disabilities and restrictions which prevent electrical engineering from making the progress that the national interests demand, and attaining at least the same level as in America, Germany and other industrial countries.

In a communication accompanying the resolutions, the committee reported that the witnesses, while taking divers views of subsidiary questions, were practically unanimous in their conviction that electrical enterprise has not attained that stage of industrial development in Great Britain which might fairly have been expected, having regard to the many favorable natural conditions, and having regard also to the achievements of British capital, labor and inventive genius in so many other branches of the mechanical arts. In considering the comparative development which might have been reached in this country, the committee had in view, not only the extent of the plant employed, but also the source of its design and manufacture. As leading indicative cases, the committee drew attention to the foreign equipment of the Central London Railway, the undisputed competition of American and Continental firms for the electrification of the Metropolitan District Railway, and the large orders executed abroad for the Dublin, Glasgow, Manchester and numerous other corporations. The committee found that the essential difference between the electrical industry as it exists in the United Kingdom and as it exists abroad is largely due to the exceptional legislative enactments, official regulations, and powers of local authorities existing in that country. Thus British electrical engineers, capitalists and others concerned have been hampered by enactments and rules which other governments have regarded as either unnecessary or opposed to public interests.

Under these conditions it has been possible for numerous local authorities to prevent any electrical supply whatever being provided within the area of their jurisdiction; and comprehensive traction schemes have been blocked, or only carried out at great unnecessary expense, owing to the opposition of one or two of the local authorities concerned. A joint select committee of the two Houses of Parliament, appointed so long ago as in 1898, reported that the law should be amended in so far as it gives local authorities the power of veto; but no steps have been taken to give effect to this recommendation. The committee considered that the acts restricting the electrical industry should be revised in order that there may be that development which is necessary to the commercial progress of the nation.

Besides the legislative enactments governing the projection, duration, expropriation, etc., of electrical undertakings, the committee considered that the Government departments should be put into such a position financially as would enable them to keep more in touch with the progress of science so as to prevent them from continuing to enforce regulations which unduly impede engineering development.

The Bergen County, N. J., Lighting System.

BY W. J. JONES.

THE lighting system of Hackensack and Bergen County, which is entirely a suburban district, has been completely changed during the past few years. In 1897 the plant at Hackensack was equipped as follows: Two 12½-kw and two 30-kw, direct-current generators; two 60-kw, 125-cycle, alternating-current generators, and a 32-light arc machine. During 1898 the above was changed to a two-phase plant, using one 50-kw and one 150-kw, belted generators, and one 350-kw, direct-coupled generator.

At this time the plant furnished current for street lighting, commercial lighting and power to three towns around Hackensack. In 1899 the electric lighting companies of Rutherford, Ridgewood and Englewood were brought under control of the Hackensack Company, and plans were made to operate these from the plant located at Hackensack. The old plants were abandoned and substations were fitted up in their stead, each of which handle the street and commercial lighting over a territory allotted to them.

The lines for the eastern section of the territory are cabled under the Hackensack River. Okonite and Standard Underground Cable Company submarine cables are used. Where the lines enter and leave the river, cable houses have been erected and supplied with cable switchboards, and extra cables are laid. With suitable plugs a damaged cable can be cut out and a new one connected in a very little time. These cable boards not only serve in the above capacity, but make it very convenient when testing for grounds on any one wire or circuit. The transmission line to Ridgewood is eleven miles, to Rutherford six miles, and to Englewood seven miles.

In 1898 the company lighted four towns, while to-day it is supplying current for street lighting, commercial lighting and power to thirty-eight municipalities, which comprise about fifty different towns and boroughs, covering a territory of about 160 square miles, with about 900 miles of wire and 9,000 poles. These towns have a total of about 2,500 series incandescent street lamps, and 125 series enclosed alternating-current arc lamps; 750 of the incandescent street lamps are of 25 cp, and about 1,750 are of 32 cp.

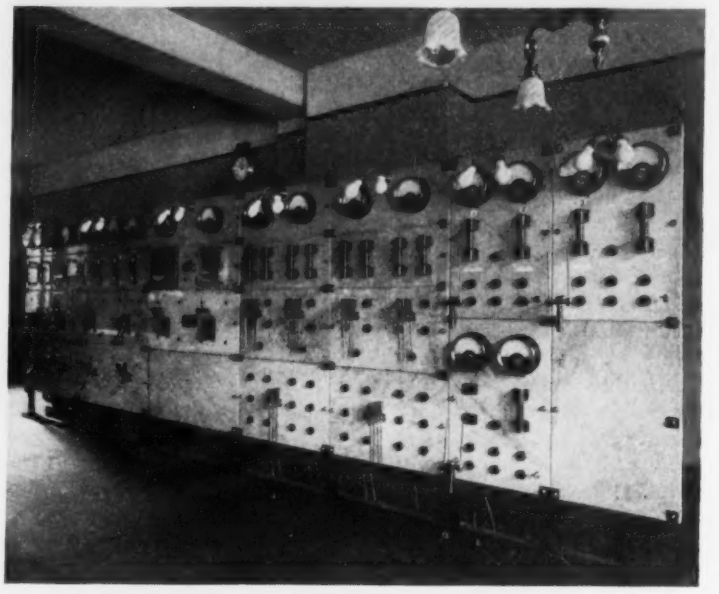


FIG. 2—SUBSTATION BOARD, ENGLEWOOD.

The switchboard at Hackensack controls 22 series incandescent circuits and two arc circuits, and is also equipped with feeder regulators for each commercial circuit, and transmission line.

The Rutherford substation has 17 series incandescent circuits, and

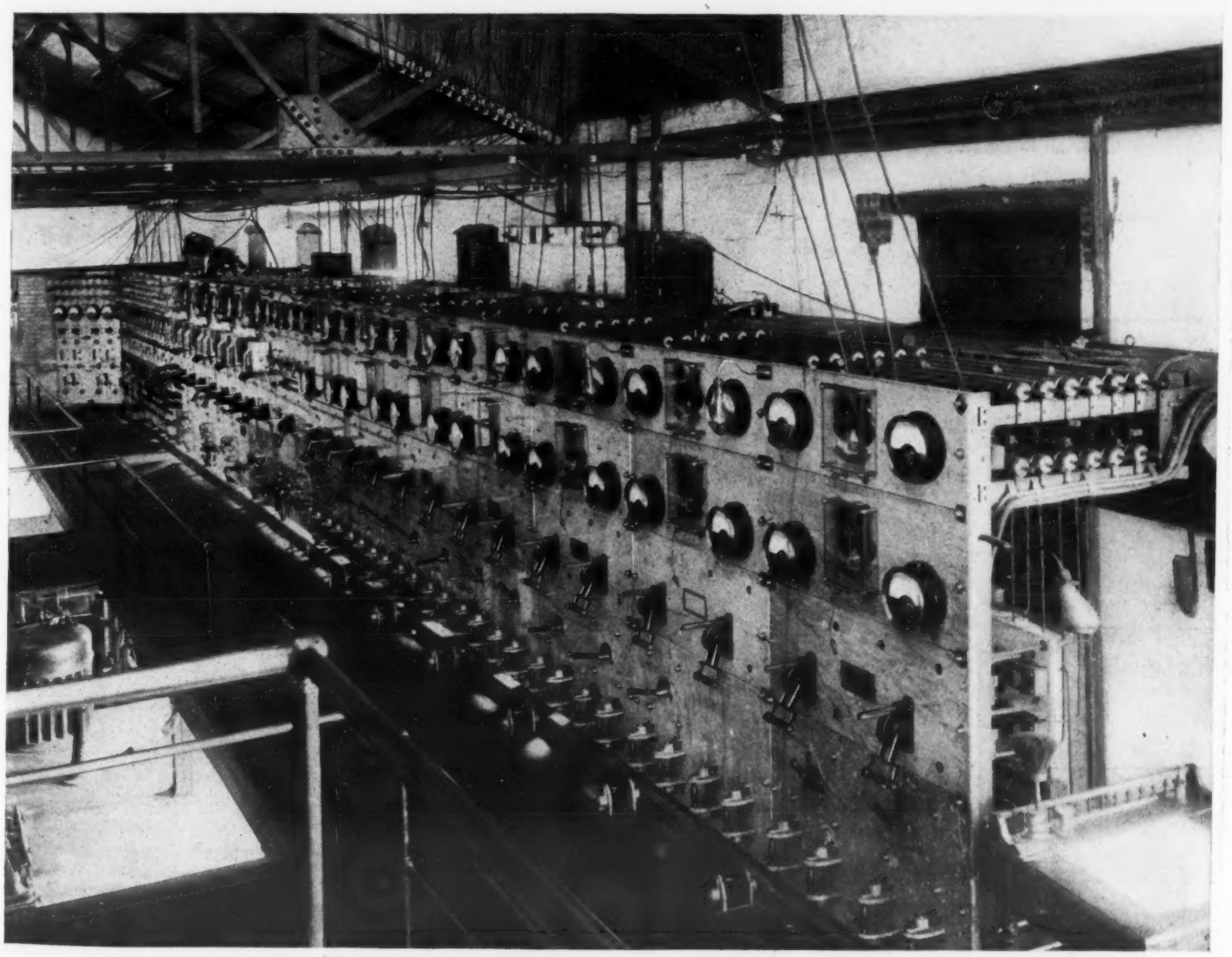


FIG. 1.—MAIN SWITCHBOARD, HACKENSACK.

one arc circuit. Ridgewood has five series incandescent circuits. Englewood has 60 arc lamps and about 320 series incandescent lamps.

The plant at Hackensack is now equipped with one 150-kw, belted, two 350-kw and one 825-kw Stanley two-phase generators, operating at 2,500 volts, and direct connected to McIntosh & Seymour vertical cross-compound, condensing engines. Blake single acting and compound jet condensers are used. The boiler room is equipped with four 300-hp Stirling water-tube boilers, and five 72 in. x 16 in. horizontal return-tubular boilers.

In suburban towns with many shade trees and scattered residences, as found throughout Bergen County, the subject of street lighting and the kind of light to adopt has been and is still quite a problem, but the incandescent lamp seems to be the one most desired, and gives a better distribution of light for a given amount of money. The amount of money appropriated for street lighting very often determines the kind of light and the type of lamp to be used. There are a number of methods of operating incandescent lamps for street lighting. A few places have adopted the system of using a multiple lamp on secondary mains run from large transformers suitably located, but the common practice is to have a series system. Following are a few of the series methods:

Shunt-box system, using a multiple lamp with a shunt-box in parallel; series system, using series lamps with film cut-out in base of lamp; series system, using multiple lamp, with lamp as shunt, and film cut-out in fixture; series system, using multiple lamp with film cut-out in socket.

With a series system using multiple lamp and cut-out in socket, the amount of current for each circuit or series of lamps may be regulated by a bank board, with a number of lamps to be cut in or out by hand, as required, to keep the current constant; by regulators operated by hand, or automatic reactive coils requiring little or no attention. By using either of these and a socket with a film cut-out, a multiple lamp can be used with a saving in cost of renewals of over 50 per cent. over the regular series lamp.

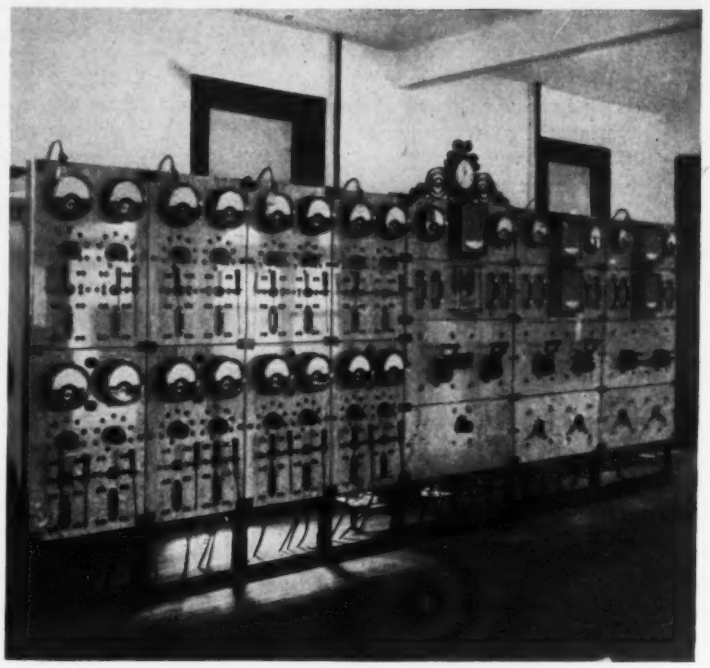


FIG. 4.—SUBSTATION SWITCHBOARD, RIDGEWOOD AND RUTHERFORD.

Some plants have each circuit or series carried back to the plant. Others run out a set of street circuit primary mains, and tap each circuit across; all of the regulating is done at the plant on the mains only, and shunt boxes or shunt lamps used for the regulation of each individual circuit.

The shunt box is quite expensive, not only in first cost, but in loss of energy while in circuit and loss due to burnouts, especially on circuits operated on 2,000 volts, especially from the effects of lightning.

To be able to control the regulation on each circuit as it is done in series arc lighting, each circuit should be run to the plant or substation and be provided with some type of regulator there.

Most of the series incandescent circuits of this company are run on a common-wire system. This common wire is of white insulation and covers a territory of from three to six circuits. Each circuit is tapped to it near the lamp farthest from the plant, and run back through a series of from 45 to 50 lamps of 32-cp, 50 volts each, using a bankboard at the plant to regulate each circuit. The common wire simplifies outside construction, as only seven wires instead of 12 are required for each set of six circuits.

About a year ago three hundred 32-cp, 50-volt lamps were installed in a section of the territory using G. E. reactive coils on 6,000 volts; about 100 lamps are in each circuit, thus leaving a little margin in each circuit for future increase of business.

The voltage of the street system in this section, both arc and incandescent, is 6,000, three-phase, stepped up from 2,400 volt, two-phase. By using reactive coils, switchboard construction is very much simplified, and the regulation on the circuits is the best that can be obtained; this, of course, increasing the life of the lamps and keeping down the cost of renewals and repairs.

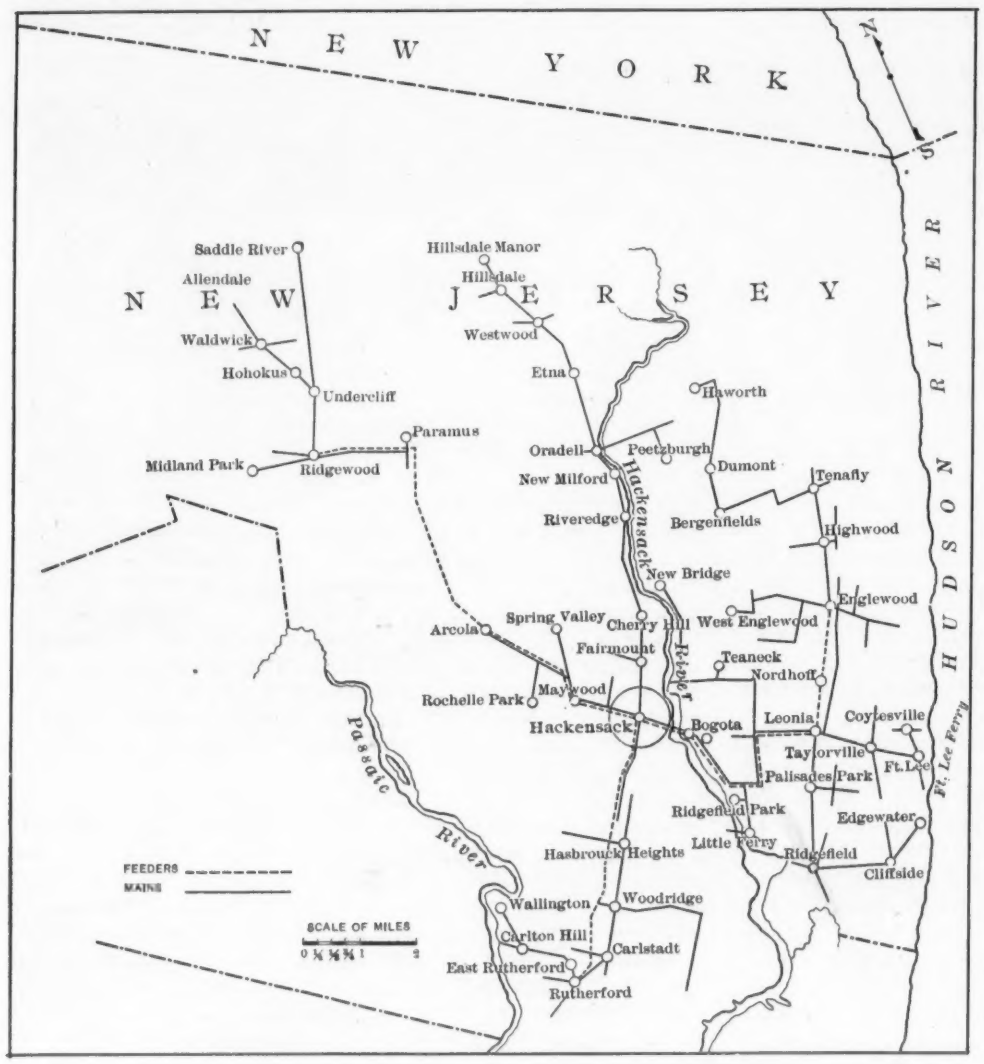


FIG. 3.—MAP OF TERRITORY COVERED BY BERGEN COUNTY LIGHTING SYSTEM.

The multiple lamp appeals to the average council and citizen much more than the series type of lamp, as the multiple lamp is somewhat longer and has a long filament, while the series lamp is very short,

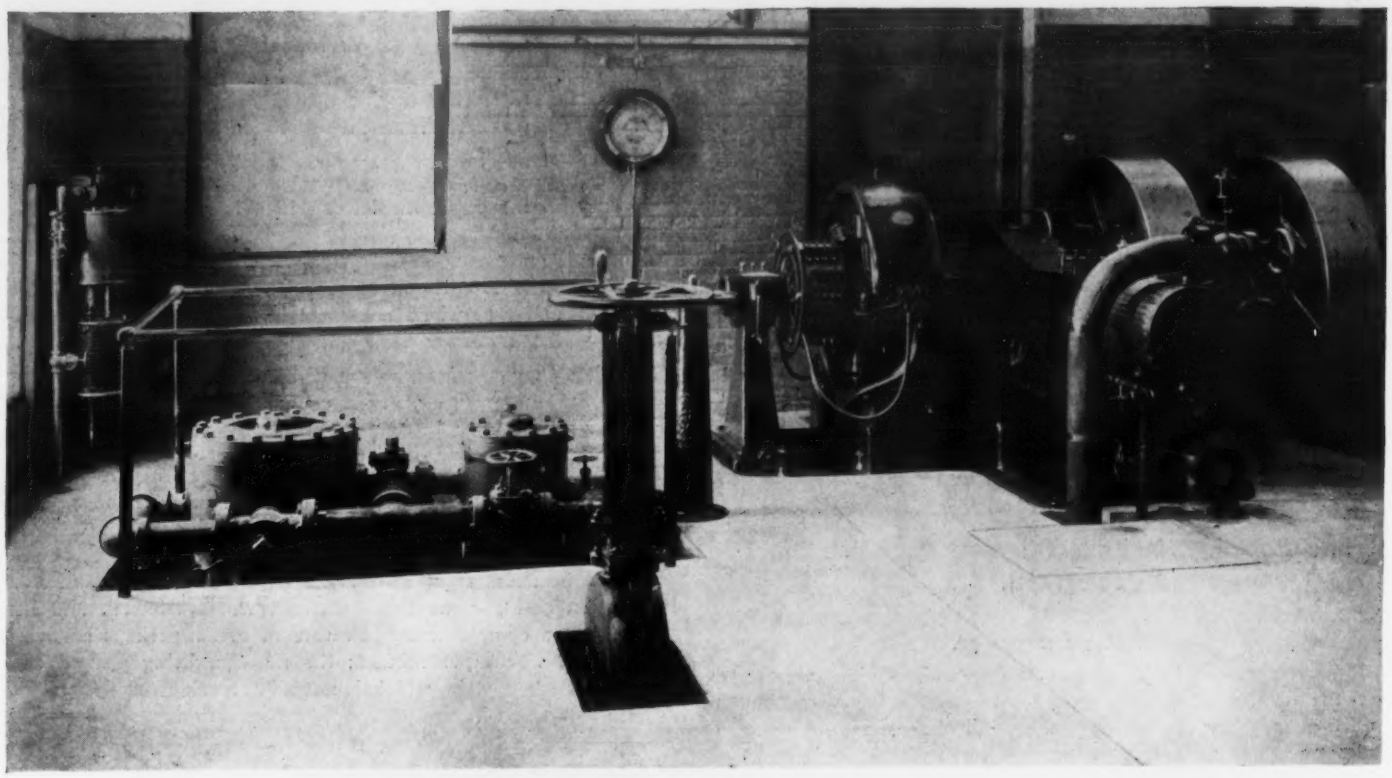


FIG. 5.—EXCITER AND CONDENSER, HACKENSACK.

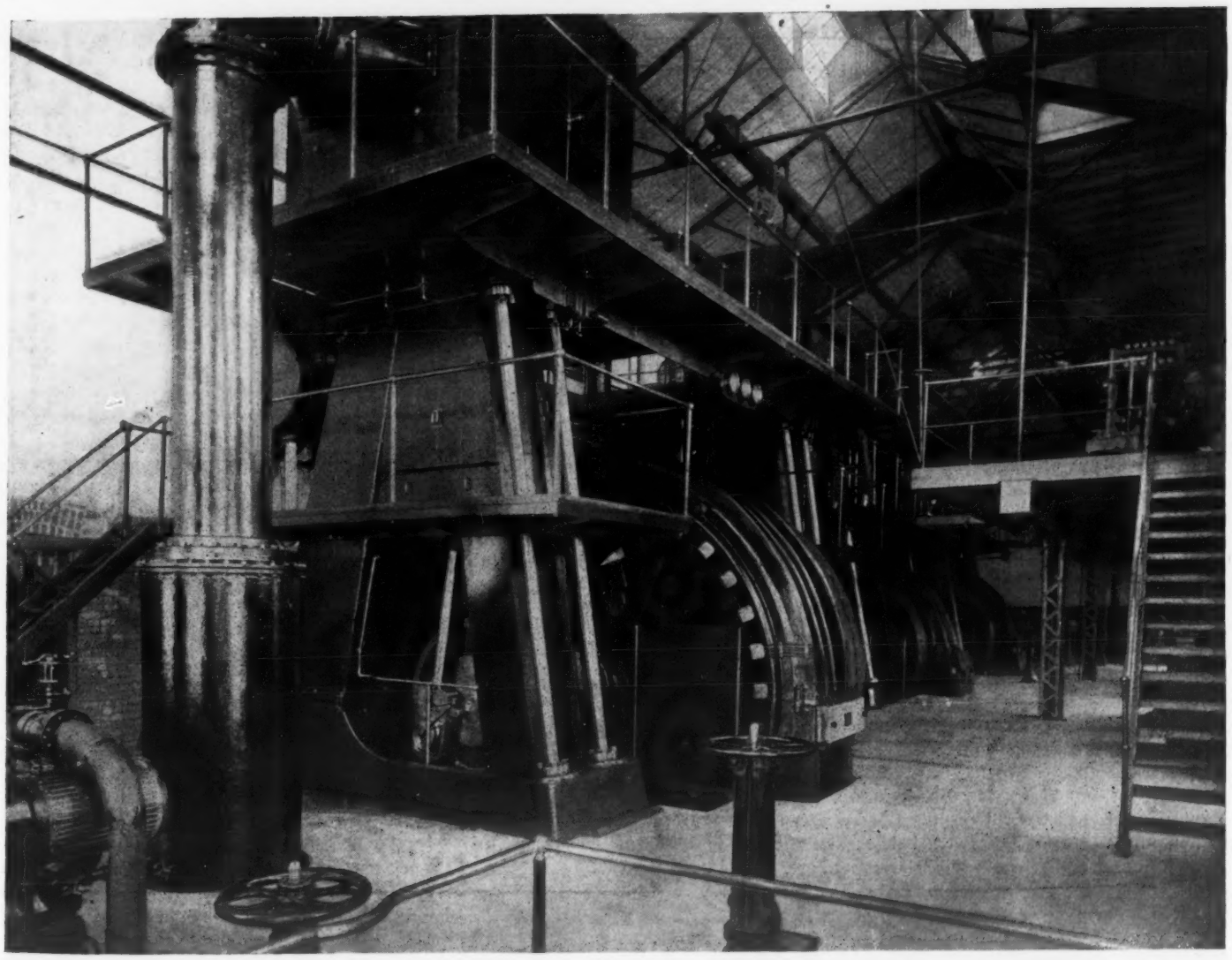


FIG. 6.—ENGINE ROOM, HACKENSACK.

and the cost is about double that of the multiple lamp. Throughout our entire system each lamp is numbered and a record is kept of the number of renewals for each lamp per year.

A record chart is kept, with fifty lamps to a chart, with the date of each change for the entire year. These charts are uniform and will last indefinitely. From these a list is given each inspector every week, with the number of lamps to be changed. Each lamp is renewed six times a year, barring burnouts and breakage. With about 4,000 lighting hours per year, this will give an average of about 656 hours per lamp. This gives the lighted district a very uniform light, as the lamps changed each week are not taken from any one street.

A weekly report is made by each inspector of the lamps and the length of time out. To these are added the station reports of circuits out and a rebate allowed pro rata for the same, to each town or municipality. This method is found to save a number of complaints from councils and town authorities, for when they know such a record is kept of their street lights and they get a rebate for lamps out, bills are more easily passed and are paid promptly.

The Buckingham Long-Distance Page-Printing Telegraph.

BY WILLIAM MAVER, JR.

FROM the days of Wheatstone, House and Hughes, almost to the present time, printing-telegraph systems have depended primarily for success upon the uniformity of revolution of a cylinder or wheel at a transmitting station with a revolving type wheel at a receiving station.

Thus if, as in Fig. 1, two wheels of equal size, having at their peripheries type letters of the alphabet, similarly arranged, are

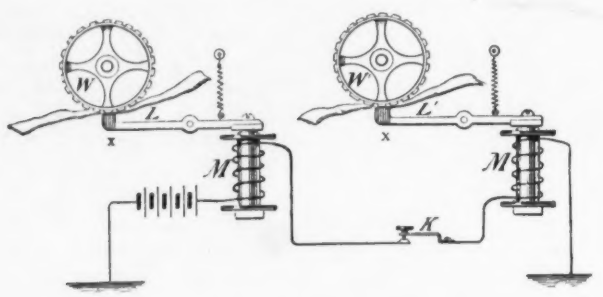


FIG. 1.—ILLUSTRATING SYNCHRONISM.

caused to rotate at equal rates of speed, it is evident that if they have started together, with a given letter on each opposite a given point, each wheel will continue to present a similar letter at that point. If, then, the wheels are suddenly stopped, and at the same time the circuit of the magnets be closed, their armatures will be attracted and the upper ends of the levers will strike against the paper strips provided, impressing thereon whatever letter may at the time be opposite thereto. It is, however, a difficult matter to obtain a uniform rotation of two such wheels, especially when they are rotated at a high rate of speed, unless their rate of rotation is controlled by some master wheel or transmitter.

In printing-telegraph systems such as are used in the well-known "ticker" service, the type wheel of the tickers in the various offices are placed under control of a transmitter, which operates them by a positive, or "step-by-step," movement.

This "step-by-step" movement is produced by a transmitter which sends out pulsations of current, generally of alternate polarity, to which a polarized magnet at the receiving station is responsive. The pulsations thus originated cause the armature of the polarized magnet to oscillate from side to side, and as it does so it operates an escapement, which, in turn, permits an escape-wheel to rotate one-half tooth, or "step," for each half-oscillation; that is, one step for each pulsation of current. If, then, there are, say, sixteen teeth on the escape-wheel, thirty-two pulsations of current will cause it to turn one complete revolution. In practice, a type-wheel having, say, thirty-two letters and other characters on its periphery is placed on the escape-wheel shaft, and hence thirty-two steps of the escape-wheel will effect one revolution of the type-wheel.

In "step-by-step" systems the transmitter is usually designed to transmit, automatically, the number of pulsations requisite to bring any desired letter on a distant type-wheel opposite a given point by the depression of a corresponding key of a keyboard at the transmitting end of the circuit. The printing is usually done by a "press-magnet" in the same circuit as the polarized magnet. The press-magnet is so constructed that it will not respond to the rapid reversals of polarity that actuate the more sensitive polarized magnets, but when a steady current of either polarity flows, one end of the armature lever of the press-magnet is raised against the type-wheel, impressing on the paper the letter which is at that instant in the printing position.

In other printing-telegraph systems, such as the Phelps in this country and the Hughes in Europe, the uniform rotation of the transmitter and type-wheel is maintained by a nearly synchronous rotation of the motors at each end of the circuit, and, in addition, by a device which corrects any slight tendency to variation from the given rate of rotation. A keyboard transmitter is also generally used on these systems.

In these systems it is evident that a considerable loss of time ensues, from the fact that frequently it is necessary to rotate the type-wheel the greater part of a revolution in order to print one letter. Thus, if the letter A follows B in a given word, it will require 31 pulsations of current to print A. If R follows C, 15 pulsations will be necessary. This is nearly equal to 15 pulsations for each letter, and for the space between words as well, and hence conduces to a comparatively low rate of speed, perhaps an average of 30 to 40 words per minute; the message being printed as received on a paper strip, which is not an agreeable form for delivery to the public; in fact, large users of the telegraph frequently specify that messages shall not be delivered to them in strip form. When also it happens that the transmitting cylinder and a printer on these step-by-step systems get out of unison, as it is termed, it is necessary to let the transmitter run free for two or three revolutions, until a unison device which holds the ticker at a unison or zero point is actuated, this frequently requiring sixty or more pulsations of current in the step-by-step systems. In the synchronous systems it is frequently necessary to allow the apparatus to run free for several minutes to obtain unison. Also, it is well known that a high degree of skill is required on the part of the operator of the Phelps and similar keyboards to secure the best results.

The Buckingham long-distance page printer is the successful outcome of the efforts of the inventor, Mr. Charles L. Buckingham, of New York, ably assisted by Mr. E. Germann, to produce a rapid printing-telegraph system adapted to operate on the longest circuits and to avoid the paper strip and other objectionable features of previous printing-telegraph systems. The success of these efforts is attested by the fact that this system has been in daily operation on some of the longest circuits of the Western Union Telegraph Company for nearly four years, transmitting 100 messages per hour between New York and Chicago in each direction, simultaneously on one wire, and printing the messages as received on the regulation telegraph blank, or on large sheets if desired.

It is evident that to obtain these results it was necessary to diminish largely the number of pulsations required for the transmission of letters and spaces below that requisite on the ordinary printing-telegraph. As a first step toward this desideratum, the Buckingham printer employs four very small octagonal type-wheels mounted side by side on one shaft, on the periphery of each of which wheels are placed eight letters and other characters, thirty-two in all. The shaft on which this combined type-wheel is mounted is so disposed that by an ingenious arrangement of five levers it may be given both a lateral and a rotary motion such that any one of the thirty-two characters on the type-wheel may be placed before a given point for printing by five pulsations of current—that is, two and one-half alternations of polarity from the transmitting station. It may also be noted here that the Buckingham receiving apparatus is so arranged that a succession of five short pulsations must always bring the escape-wheel of the receiving apparatus to the unison position, in a manner to be explained subsequently.

For the actual printing of the letter the pulsation required to produce the space between letters and words in the Morse and Wheatstone systems is utilized. Hence the selection and printing of any character are brought about in the Buckingham system by a cycle of six pulses of current in all—that is, three alternations of polarity. These pulses are, however, of varying length, akin in this respect to the Morse alphabet. For example, the letter A will be selected by a dash and two dots, B by a dot, space, dash, space, dot (. — .), the space, as in the Wheatstone system, being made by

a negative current; and since it is known that a succession of five short and long pulses can be arranged in thirty-two different ways, a different combination is readily obtained for the twenty-six letters of the English alphabet and six other characters.

These combinations form what is termed the Buckingham alphabet or code, given herewith:

A — . .	I . . —	Q — — . —	Y — . .
B . — .	K — — —	R . — .	Z — . —
C — . —	J. . — —	S — — .	& — — —
D — . .	L . . —	T . .	Comma (,) — — —
E . — .	M. — — .	U . . .	Period (.) — — .
F . — . .	N. . — .	V — — .	Question (?) — . —
G . . —	O . . .	W. — . —	Dash (—) . — —
H . — —	P . — —	X . . —	Space (blank) ...

Inasmuch as the prolonged negative or positive pulse of this alphabet, like that of the dash of the Wheatstone-Morse alphabet, is equal to three short pulses (that is, as the dash is to the dot), the letters that occur most frequently in the English language are, in the Buckingham alphabet, allotted the combinations which contain the least number of prolonged impulses.

In the feature of preparing the messages for transmission, and in the actual transmission of the messages, the Buckingham system is almost identical with the Wheatstone automatic system. Consequently, the messages are prepared for transmission by being perforated in a double row on a paper strip, which is then passed through the Wheatstone transmitter, and if the Wheatstone receiver were employed at the receiving end the messages would be recorded on the paper strip as dots, dashes and spaces, differing from the Wheatstone records only as the Buckingham alphabet differs from the Morse alphabet.

The Wheatstone transmitter is shown in Fig. 2. It is said that Wheatstone obtained his idea for this instrument from the Jacquard

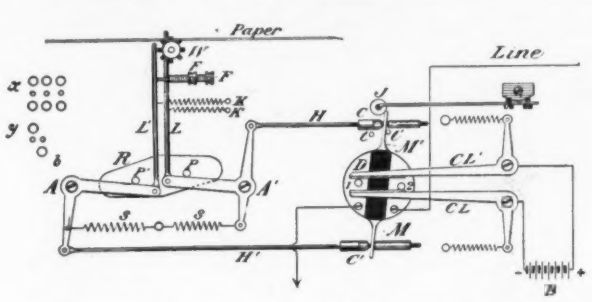


FIG. 2.—THEORY OF WHEATSTONE AUTOMATIC TRANSMITTER.

loom, which in its operation it somewhat resembles. It is seen that the perforated paper is caused to pass above two vertical rods, which receive a tendency to rise vertically by the springs shown, but are limited in their motion by pins on a rocking beam, which, during the operation of the apparatus, is rocked by suitable machinery, and thus, with the rods, presents the appearance of an inverted walking beam, one rod rising with the rocking beam and the other being depressed alternately. When the holes in the paper come immediately above the rods, the latter pass through them and complete a full phase. Hence, if there are a succession of holes in each edge of the paper strip, the rods will make complete excursions, and in that case the levers attached to the lower ends of the vertical rods will operate a pole-reversing device which will send out a succession of short positive and negative currents to the line. When, however, the holes in the paper come at suitably designed intervals, so that at times a rod in rising comes in contact with the paper, it is thereby prevented from rising further with the rocking beams, and thus at that time a prolonged pulse of one or other polarity goes to the line, since at that time the levers of the pole-changers do not alter position, and by suitably arranging the holes in the paper short and long pulses of current may be transmitted in any desired order.

The transmission of the six pulses of alternating polarity thus arbitrarily arranged for each character of the Buckingham alphabet results in the operation of a Wheatstone polarized relay in the main line at the receiving end of the system, which relay by its armature controls a local circuit in which are a governing relay, a unison magnet and an escapement magnet, which latter imparts, by means of an escapement, a step-by-step motion to a "sunflower" or distributor of peculiar construction, to such purpose that, with the co-operation of the governing relay, and depending on the duration of the incoming pulses and the order of their arrival, one or more selecting relays are operated, and these, in turn, cause the operation of the type-moving levers which bring a desired letter on the type-wheel to the printing position.

The Buckingham printer is thus a positive or "step-by-step" system in which an escape-wheel, and with it the sunflower, is caused by a cycle of six pulses of current, one or more of which are prolonged, to undergo a cycle of six steps for each letter or character printed. The term prolonged pulse is a relative term, as will be understood if it is considered that when the system is operating at the rate of 100 words per minute the length of a prolonged pulse is about the one-fortieth part of a second.

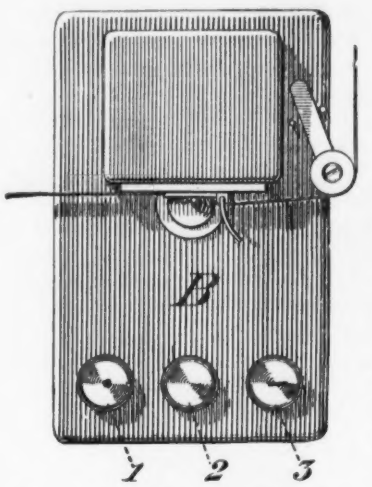


FIG. 3.—WHEATSTONE PERFORATOR.

Before further considering the receiving apparatus, the manner of preparing messages for transmission by the Buckingham system will be described.

First it may be noted that the ordinary method of preparing messages for transmission by the Wheatstone system is a somewhat tedious and arduous process. The apparatus consists essentially of a set of five metal punches, each moving within a close-fitting case, Fig. 3, and which, by suitable mechanism, may be pressed outwardly beyond the case a short distance. The paper to be perforated is caused to pass close to the edges of the punches, Fig. 4. The inner ends of the punches are adjacent to three rods or levers, which connect with three keys or discs, 1, 2, 3, the dot, space and dash keys, respectively. These keys are placed in a position convenient for the operator, who depresses them by means of a rubber-tipped mallet in each hand. Depressing the dot key perforates three vertical holes in the paper, two large and one small. Depressing the dash key perforates four holes, two small central holes, and two large holes at an angle with each other. Depressing the space key perforates a central hole only. The act of depressing a key also causes the paper to be fed by a small star wheel meshing in the central holes. The rate at which a Wheatstone puncher can prepare messages is from twenty to forty words per minute.

One of the important features of the Buckingham system is that it dispenses with this mallet method of punching messages, in which every element of a letter has to be punched separately by the operator, and, instead, it employs a method in which all the elements of a given letter are perforated by the depression of one key on a keyboard corresponding to that of the Remington keyboard, and by means of which messages can be prepared at a speed which is only limited by the capacity of the operator to manipulate the keyboard,

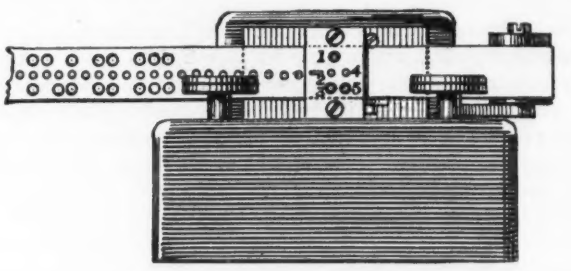


FIG. 4.—WHEATSTONE PERFORATOR.

some data relative to which will be given towards the end of this article.

This keyboard perforator is shown in the accompanying illustrations, Figs. 5, 5*a*; the operation of which may be described in general terms as follows: Under the levers of the keys a number of fine piano wires are stretched, at right angles to the key levers, at intervals of about ¼ of an inch. These wires are secured at the left end, while at the right end each wire is attached to a crank lever which controls a circuit in which is an electromagnet. There are in all twenty-five of these wires, sixteen of which through

their crank levers control an equal number of punching magnets, and nine of which control nine paper-feed magnets. The key-levers are provided with inverted stirrups on their under edges, the actual number and placing of which is different for each letter, and when a given key lever is depressed these stirrups engage with certain of the piano wires, which latter operate the crank levers with which they are connected and close the circuits of their respective electromagnets. Hence a given key will always operate the same electromagnet.

The punches in the apparatus are sixteen in number, of the same diameter as those used in the Wheatstone puncher, and are placed in two rows, eight in each row, one series of which perforates the necessary upper holes in the paper, the other series the lower holes in the paper. There is thus an upper and a lower row of punches, the upper row being caused to punch the paper from one side, the lower row from the opposite side. Behind each punch there is placed a crank lever, one for each punch, so arranged that it may be operated by the armature of a certain one of the punching magnets, which latter are compactly arranged in a vertical row under the punches for that purpose, as may be partially seen in the illustration. It then follows that when a given key is depressed it will close a certain six of the circuits containing punch magnets, which, in turn, will operate the punches connected therewith, thereby perforating three upper and three lower holes in the exact order required for the transmission of the letter represented by the key so depressed.

At nearly the same instant the hammer end of the armature lever of a magnet termed the "knock-down" magnet has been placed above that pin which is now raised at the fixed stop. When the operator removes his finger from the key, allowing it to ascend, the circuits of the punch magnets and feed magnets are opened, the

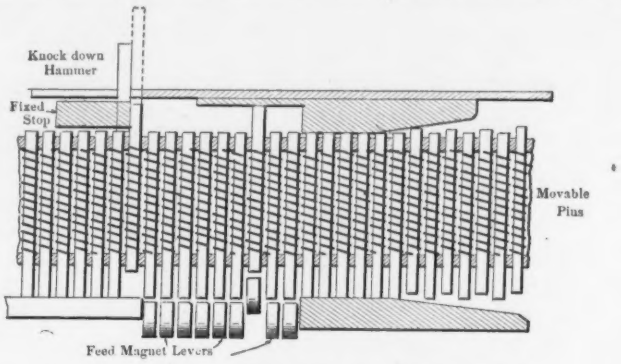
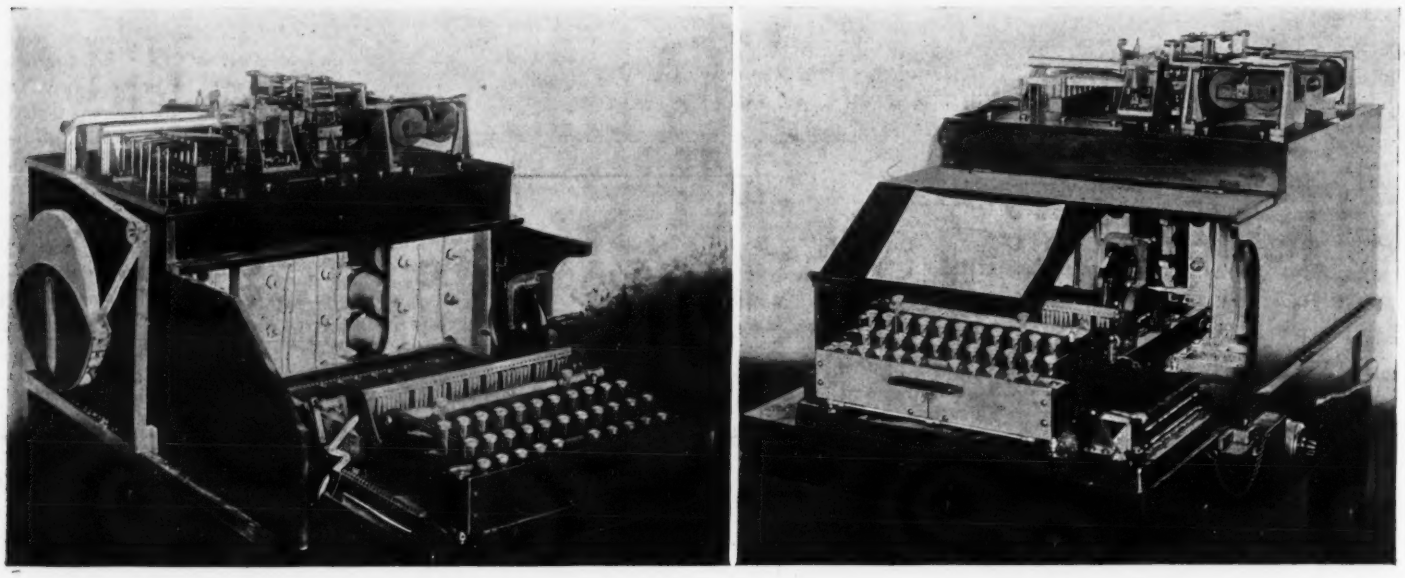


FIG. 6.—THEORY OF PERFORATOR PAPER FEED DEVICE.

punches are withdrawn from the paper, and, nearly simultaneously, the hammer of the knock-down magnet hits the pin under it, depressing it below the fixed stop, whereupon the feed-wheel quickly turns, drawing with it the paper strip, until the pin last raised arrives at the fixed stop, when the wheel is again halted and the apparatus



FIGS. 5 AND 5A.—BUCKINGHAM KEY-BOARD PERFORATOR, FROM OPPO SITE SIDES.

It should be noted that the small central holes in the paper strip are prepared in advance by a separate machine at a very high rate of speed.

Inasmuch as the letters of the Buckingham alphabet, like those of the Morse alphabet, are of variable length, it is evident that a variable paper feed device must be employed in this punching apparatus. This device is outlined in Fig. 6. It consists of a drum-shaped wheel, 1.6 inches in diameter, on the periphery of which are placed small teeth of the proper size and so spaced as to mesh into the central holes of the perforated paper. This wheel is carried on a vertical shaft driven by a motor-wound barrel spring.

This variable feed action is automatically brought about in a very simple manner. There are arranged vertically around the edge of the feed-wheel (Fig. 6) a number of movable pins, frictionally held in any position by close-fitting spiral springs. These pins normally project below, but may be raised above the upper surface of the feed-wheel. Normally, also, some one of these movable pins is always thus raised, and while so raised it engages with a fixed stop placed above the wheel, whereby the wheel's rotation is stopped. When a key-lever is depressed one of the feed magnets referred to is operated, and through its armature lever it drives up another of the movable pins which is distant from the fixed stop a space equal to the length of the letter represented by the key so depressed. Simultaneously with the raising of the latter pin the proper punching magnets have also been actuated and have punched the paper. is ready for the punching of another letter. When the punched paper strip passes the feed-wheel it enters a curved chute (seen in the photograph of the perforator), which strips it from the teeth of the feed-wheel, and it is then ready to be "run" through the Wheatstone transmitter.

In the operation of this keyboard perforator the operator depresses the keys precisely as in the case of the ordinary typewriter, depressing a space key once for the space between the words. To prevent the operator over-running a line, an escape-wheel, termed an indicator, is provided, which is rotated step by step with each key depressed. At the zero point of this wheel, which corresponds with the end of a line, there is a slot into which a pawl drops and locks the apparatus. To unlock it the operator depresses a line space key, which at one operation throws the pawl out of the slot and punches a line space. On the periphery of the indicator, which is plainly seen at the right of the keyboard, is a white mark, which comes into view as the end of the line is approached, giving the operator visual warning to that effect. Provision is also made whereby when a message, or any part of it, ends in the middle of a line the operator may manually turn a knob on the axle of the indicator, which brings it at once to the zero or locked position, ready for the beginning of a new line.

The Buckingham page printer is shown in front and rear view in the illustrations, Figs. 7, 8. To avoid the delay that would necessarily follow the attempt to move a paper carriage in the man-

ner of the ordinary typewriter and page-printing telegraph systems, Mr. Buckingham employs a novel device. The telegraph blanks are arranged in the form of a tube, which is placed loosely over a fixed tubular support. A row of small holes is perforated in advance along the margin of the blank, and the teeth of a small star-wheel mesh into these holes. This star-wheel is carried on the inner side of an annular toothed wheel supported on roller bearings, and which may be seen in Figs. 8, 8*a*. Gearing operated by a motor-wound clock spring gives this wheel a tendency to rotate, but under the control of the printer escapement it acquires a step-by-step movement around the tubular support. There are seventy-four teeth on this ring (sufficient to carry it once around), which correspond with the number of letters and spaces on one line of a telegraph blank. Near the zero point of the escape-wheel several of its teeth are omitted for a purpose presently to be mentioned. While a message is being printed, letter by letter, this annular ring, and with it the star-wheel, is moved step by step around the supporting tube, the star-wheel being held in one axial position by the engagement of its teeth in three circumferential grooves on the supporting tube (Fig. 9), until, at the end of a revolution, the paper is almost at the place of beginning. Since certain of the star-wheel teeth are meshed with the perforations in the paper tube, the latter will obviously be carried around the fixed tubular support, step by step, and thus as printing goes on a new surface is regularly fed beneath the type-wheel. This wheel is visible in Fig. 7, in which a section of the tube has been removed for purposes of illustration.

entrance of the inclined grooves the escape-wheel, from which several teeth are omitted, jumps a corresponding distance, and with it the annular ring, with the result that the annular ring simultaneously moves a distance equal to several short steps, and the paper is advanced a line, with but one step of the escape-wheel; in other words, with but one pulse of current.

Figs. 10, 11, 12, 13 show details of the receiving, unison and

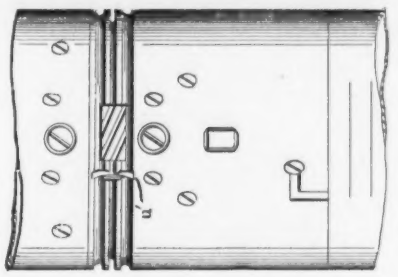
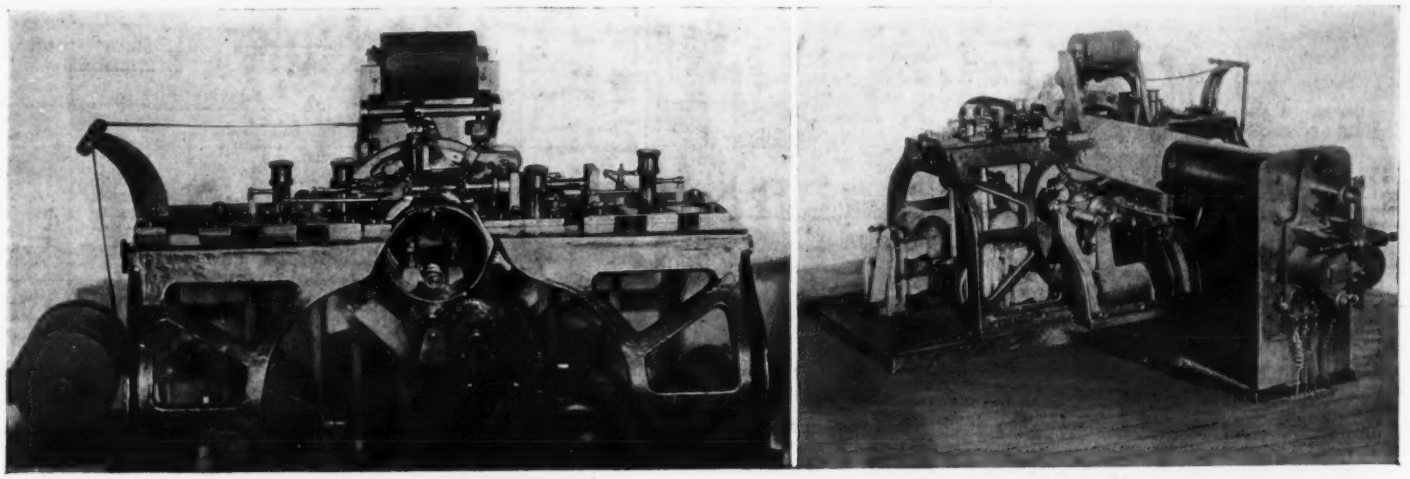


FIG. 9.—SUPPORTING TUBE.

printing apparatus. The main-line polarized relay and the apparatus which it directly controls are shown in Fig. 10. Its armature controls two branch circuits, in which are the sunflower escapement magnet, a unison magnet and a governing relay. These have each two coils reversely wound, and in the case of the escapement magnet the effect is to oscillate its armature from side to side in common with the armature of the main-line relay. The unison



FIGS. 7 AND 8.—FRONT AND REAR VIEWS OF BUCKINGHAM PRINTER.

It will be seen that the circumferential grooves on the tube turn off at an angle, or incline, at a point (Fig. 9) which corresponds with the end of a line on the paper sheet or tube. When the star-wheel in its course passes through these inclines it must turn on

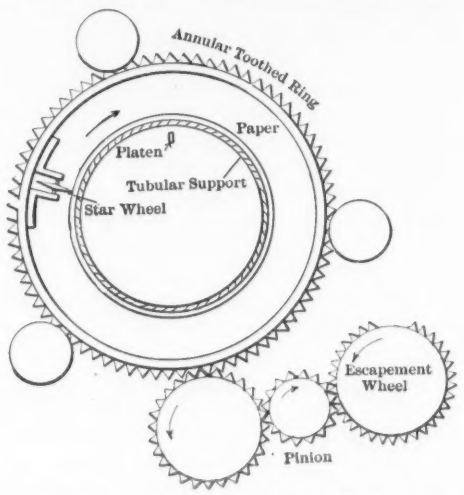


FIG. 8A.—END VIEW OF ANNULAR RING PAPER FEED GEARING.

its axis, causing its teeth to mesh with new perforations in the paper, and advancing the paper thereby the distance of one line along its support. At the time when the star-wheel arrives at the

magnet is polaried, and its coils are so connected that a current through one of its coils corresponding to a negative current on the main line tends to assist the induced magnetism which a current in the other coil (corresponding to a positive current on the main line) opposes the induced magnetism of the magnet. The adjustment of the retractile spring of the magnet is such that its armature will not be attracted by short pulsations of either polarity, nor by prolonged positive pulses, but it will be attracted by prolonged negative currents. The result of this is that when short and long positive and short negative currents are coming over the main line the hook on the end of the armature of the unison magnet is always in the path of the teeth of the unison wheel on the same shaft as the escape wheel, but when a long negative pulse is received the armature is attracted, and the hook is withdrawn from the path of the teeth. The space between any two of the teeth on the unison wheel is equal to the space between any three of the teeth on the escape-wheel. Six pulses of current will move the escape-wheel a distance of three teeth. Hence six pulses will also move the unison wheel a distance equal to that between two of its teeth. Therefore so long as the escape-wheel is in unison with the received pulses of the latter, the hook will always be drawn out of the path of the teeth, since each letter of the Buckingham alphabet is followed by a long negative pulse, and if at any time the apparatus should get out of unison, it is seen that in this way five short pulses will hold it at the unison or zero point, as previously stated.

The teeth of the unison wheel also perform another important

office. There are six circuit-closing levers pivoted as shown, of which five are on one metal support; the sixth is insulated therefrom. The arrangement of these levers relative to the teeth is such that when the unison wheel moves a distance equal to the space between two of its teeth these levers close their respective circuits at 1, 2, 3, 4, 5, 6 in quick succession, beginning at 1. In other words, each cycle of six pulses, whether of long or short duration, will bring about a consecutive closing of the circuits controlled by these levers for a purpose presently to be mentioned. Of course, a long

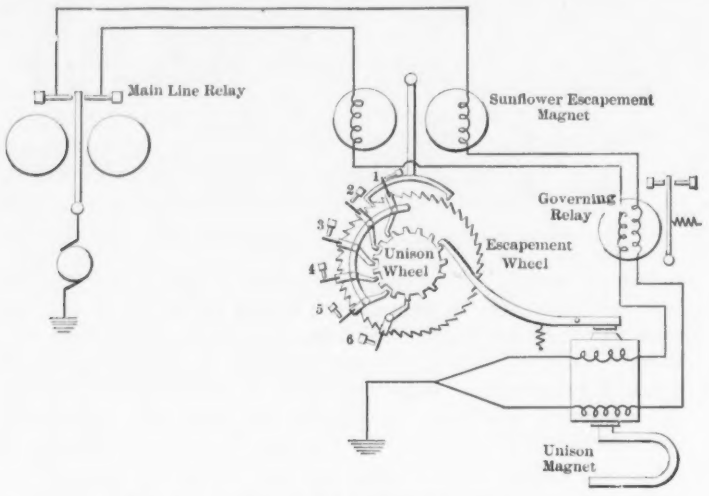


FIG. 10.—DIAGRAM OF RECEIVING APPARATUS.

pulse will cause a circuit closer to dwell longer on its contact than a short pulse.

The retractile spring of the governing relay is so adjusted that its armature will not respond to short pulses of current, but will respond to prolonged pulses of either polarity. This feature is utilized in connection with the circuit closers of the distributor, or sunflower, and certain relays, termed selecting relays, of which there are five, shown in Fig. 11. These relays, known as Nos. 1, 2, 3, 4, 5, also have two coils, reversely wound. The circuit from one of the coils of each relay is connected to the correspondingly numbered contact post of the sunflower, but this circuit, it may be seen, can only be fully completed when the armature of the governing relay is attracted. Each of the selecting relays, by its armature, controls an electromagnet, which latter, by its armature, mechanically moves a lever that is connected with the type-wheel moving devices. These are termed the type-wheel magnets.

Whenever, in the course of the incoming six pulses that repre-

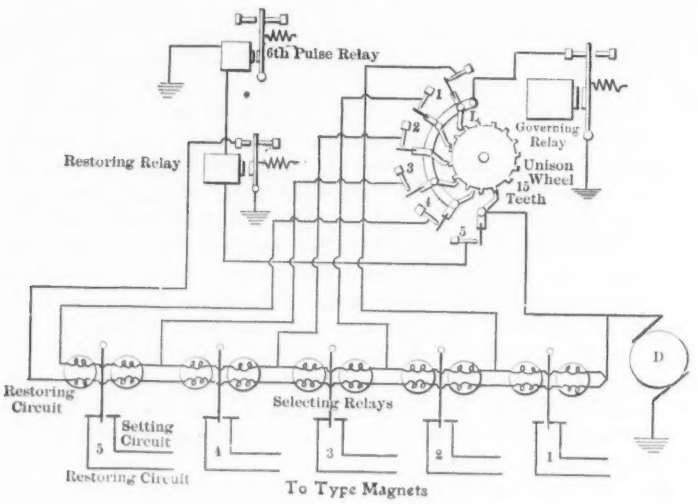


FIG. 11.—DIAGRAM OF UNISON AND SELECTING APPARATUS.

sent and print a character, one or more of the pulses are prolonged, there will, of course, also be a prolonged pulse or pulses in the local circuit of the governing relay, which will attract its armature, as in Fig. 11. Assume, for example, it is the first pulse. At this moment circuit-closing lever 1 is on a tooth of the unison wheel, and its circuit is closed at the contact post 1. Hence, at this instant (the governing relay also being closed) the circuit of No. 1 selecting relay is completed, and being thereby actuated by current from dynamo D, throws its armature to the right, operating a type-magnet No. 1. This magnet, by its armature levers, will move the type-wheel into a position for printing the letter A, and if there be no other prolonged pulses in the cycle up to the sixth pulse that letter will be printed by the sixth pulse. Had the third and fifth pulse of the cycle also been prolonged, the third and fifth selecting relays would have been operated, with the result that the letter K would have been printed.

The sixth circuit-closing lever is the last to act (it may be said to be the first and last, for it rests normally against its contact point, but it leaves it at practically the instant that No. 1 makes its contact). This lever, when closed, energizes two relays, one of which, the sixth pulse relay, operates the press-magnet, the feed-magnet, an ink-ribbon magnet and a dogging magnet; the other is the restoring or resetting relay, which closes the restoring circuit through the selecting relays and type-wheel magnets, and thus resets those instruments to normal position after the selection and printing of a letter. It need not be said that these operations

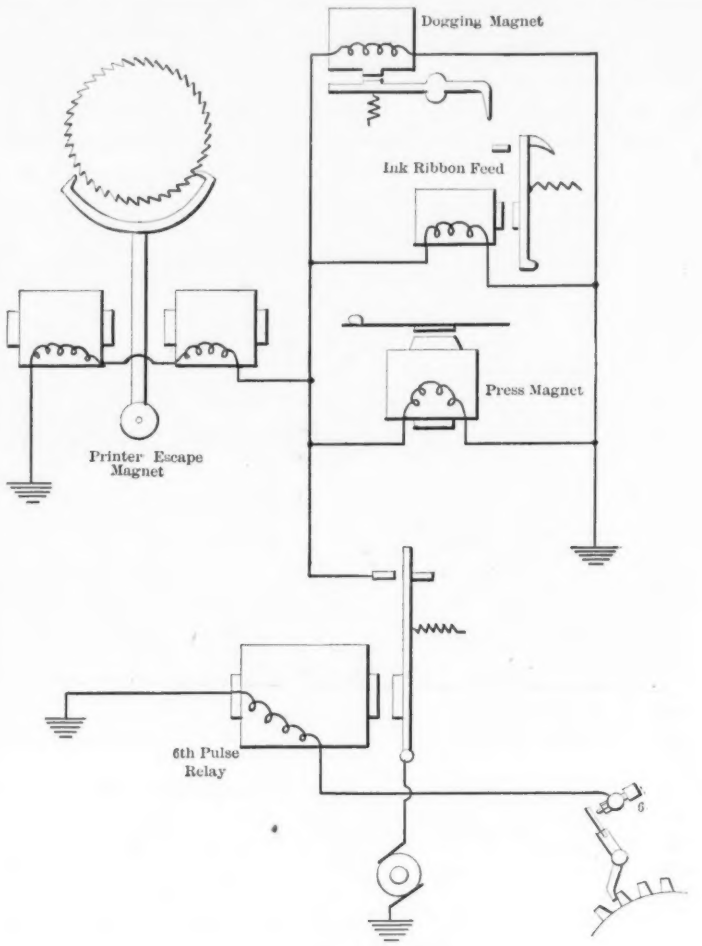


FIG. 12.—DIAGRAM OF PRINTING CIRCUITS.

follow each other very quickly. It is obvious that the apparatus operated by the sixth pulse relay must operate before the restoring apparatus performs its part. This is ensured by giving the armature lever of the restoring relay a longer distance to travel before it makes its contact, and also by suitable adjustment of the retractile springs of the armatures.

The circuit connections of the instruments operated by and in connection with the sixth pulse relay are outlined in Fig. 12.

The ink-ribbon feed magnet actuates a step-by-step ratchet and pawl device which moves the inking ribbon under the type-wheel. The dogging magnet plays an important part in steadying the type-wheel during the process of printing. This it does by means of a small cylinder on the same shaft as the type-wheel on the surface of which cylinders thirty-two small holes are arranged to correspond with the characters on the type-wheel. When the dogging magnet is operated, which will be after a desired letter is approximately in the printing position, its armature drives a dog or pin into one of these holes, thereby adjusting and locking the type-wheel

in a given position until the printing is effected, whereupon it is released. The printer escapement magnet operates or controls the train of gearing, which results in feeding the paper around and along its support, as already explained.

The manner in which the type-wheel is brought into any one of the thirty-two possible positions, considered aside from the alphabet, is perhaps the most unique of the numerous novel features of the Buckingham printer.

The electromechanism for this purpose is schematically outlined in Fig. 13. It is also visible in the accompanying photograph. The type-wheel is securely mounted with the dogging cylinder on a horizontal shaft. This shaft receives an endwise motion from the horizontal levers on the left, and a rotary motion from those on the right. In shop phrase, these horizontal levers are termed whiffletrees. The vertical arms 4, 5, connected with type-lever magnets 4, 5, move the horizontal levers which give the endwise motion to the type-wheel. The arms 1, 2, 3 move the right-hand levers which impart by suitable intervening mechanism the rotary motion to the type-wheel. The whiffletrees are connected by suitable links and pins to their respective arms, and are so pivoted and interlinked that a movement of arm 5, for example, to the right will move the type-wheel (whose shaft is attached by a swivel connection to the left-hand levers) a distance equal to the width of

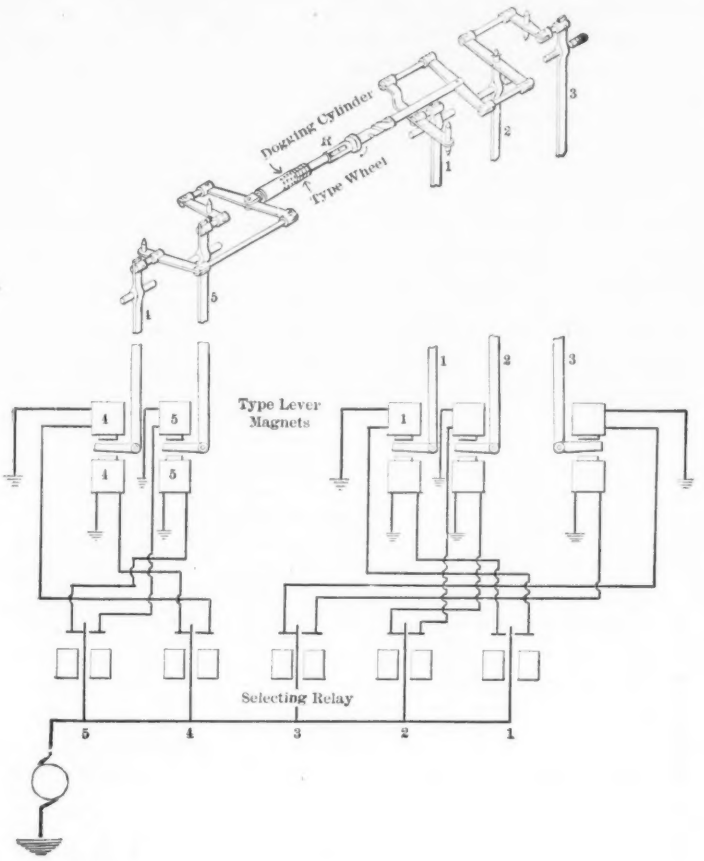


FIG. 13.—TYPE-WHEEL MOVING MECHANISM.

one of the type-wheel rings to the left. When arm 4 only is moved, it shoves the type-wheel shaft lengthwise a distance of two rings of the type-wheel to the right. When both arms are moved, the type-wheel is moved a distance equal to one ring to the right. As in the normal position of the type-wheel the second ring from the right is in the printing position, it is clear either of the other three rings may be brought into a printing position by the single and combined effects of two endwise adjusting arms.

The lengthwise or reciprocal movements of the right-hand levers impart a rotary motion to the type-wheel shaft by the intermediary of a spiral slot in a sleeve through which a pin attached to a rod *R* projects. This rod is connected by a link to the right-hand whiffletrees. The type-wheel shaft enters the left end of the same sleeve, in which it moves freely lengthwise. A pin on this shaft projects through a straight slot in such manner that when the sleeve rotates in either direction the pin compels the type-wheel shaft to turn with it. The rotating levers are so adjusted that arm 1, when moved alone to the left by its magnet, will turn the type-wheel as a whole one-half of a revolution in the direction of the arrow shown at the shaft. Arm 2, when moved alone to the right, turns the type-wheel two-eighths of a revolution in an opposite direction. Arm 3, moved alone to the right, turns the type-wheel one-eighth of a revolution in the same direction as arm 2. Arms 2 and 3, acting together, jointly turn the type-wheel three-eighths of a revolution in a direction opposite to the arrow, while arms 1 and 2, acting together, but oppositely, will turn the type-wheel two-eighths of a revolution in the direction of the arrow; and by these means any one of the characters on the type-wheel may be placed in the position for printing with a maximum of five prolonged pulses apart from the final prolonged negative pulse for printing and restoring the apparatus to normal after printing.

The press-magnet is seen at the rear end of the tubular support. Its armature lever is connected with the printing platen by means of a rod attached to a crank lever, the platen being arranged within the tube and driving the paper against the type-wheel through an opening in the tube.

As already noted, the method of transmitting messages by the Buckingham system is identical with that of the Wheatstone automatic telegraph system.

The speed of the operators in preparing messages by the Buckingham keyboard perforating machine for transmission by the Buckingham system has increased with the increased skill of the operators, and is now not less than eighty words per minute. This rate of speed, it may be said, is greater than that at which the most expert operator of a typewriter could transcribe the same messages on ordinary page copy by the Remington or other typewriter. This is due to the fact that the operator of the Buckingham keyboard perforator has practically no sheets to change, the paper strip coming in rolls sufficient for 100 messages. Furthermore, the extent of depression of the key levers of this machine is less in point of distance traveled than the levers of the ordinary typewriter, and it is easier to operate, since it has practically no friction to overcome and no work to do other than to close the circuits of the punching and feed magnets. All the business transmitted by the Buckingham system is prepared by this key-board perforator, and it may be added that two-thirds of all the business transmitted over the regular Wheatstone automatic circuits from the New York office is also prepared by this keyboard perforator, it being understood that it is only a question of arranging the proper combination of stirrups under the key levers to adapt this keyboard perforator to any dot and dash alphabet; the piano wires, feed and punch magnets remaining unchanged.

In the operation of receiving messages by this system an attendant places the telegraph blank in its tubular form over its support, until it meshes with the star-wheel, as stated, to facilitate which a slot at right angles to the circumferential grooves is provided (u^1, Fig. 9).

The reception of message then proceeds. At the end of the first line, which contains the number, originating station and date of the message, also at the end of the address and at the end of the message, a blank space is provided in the perforated strip at the transmitting end. At these intervals the attendant operates a manual device and advances the paper one line. At all other times the line space movement is automatic. When the message is completed the attendant opens up the paper tube by running a knife point through the row of perforations on the margin, when the message is practically ready for delivery.

An expert attendant quickly detects any imperfect signals, such as might be caused by wire trouble of any kind, by a break in the rhythm of the working of the receiving apparatus, and in the event of any appearance of error he signals to the transmitting operator accordingly. In this way incipient errors due to line and instrument troubles are detected with practically the same facility as on the regular Morse circuits.

The rate at which messages are regularly transmitted between New York and Chicago by the Buckingham printing-telegraph on a duplex circuit is about 100 average messages in each direction, or 200 messages per hour on one wire. The length of this circuit is 974 miles, but the ordinary Wheatstone repeaters are inserted at Buffalo, which is 444 miles from New York and 532 miles from Chicago. The wires used are the ordinary overhead copper wires of the company, measuring from 3 to 5.5 ohms per mile, and the

system is, of course, operated under all prevailing conditions of capacity, self-induction and inductance effects from other lines to which the contiguous circuits may be subjected.

On several occasions the system has been worked at full capacity, to test its accuracy of transmission and reception. The matter transmitted on these occasions consisted of ordinary newspaper press reports, and was received on sheets of foolscap. On one occasion, from Chicago to New York, 2,429 works were transmitted in 23 minutes 54 seconds. On another, 6073 words were sent and received in 60 minutes and 13 seconds. On still another occasion 9126 words were sent in 91 minutes and 18 seconds, all without an error in the printed copy. This is at an average rate of 100 words per minute. These figures include the time lost in changing the sheets, which, at the date of the tests, required six seconds for each change. By an improvement in the apparatus this time has been reduced to one second. It is estimated that over 1,500,000 messages have been transmitted by this system since its introduction upon the lines in question.

In conclusion the writer begs to acknowledge his many obligations to Mr. Buckingham for facilities afforded him in gathering data concerning this interesting system for publication in detail in the author's work, *American Telegraphy,* considerable of which data, it may be said, has been drawn upon in the preparation of this article, which is the first consecutive description of the Buckingham printer that has thus far been given to the public.

A Polyphase Motor System for Traction Purposes.

At the annual meeting of the American Institute of Electrical Engineers, held May 20, two papers were read relating to polyphase electric traction. One paper was communicated by Mr. Ernst Danielson, of Westeras, Sweden, and the other was read by Mr. Carl L. De Muralt, of Zurich, Switzerland. The latter paper, an abstract of which will appear in the following issue, gives an account of all the more important polyphase electric railways that have been installed in Europe.

The paper by Mr. Danielson deals with an arrangement of polyphase motors, which makes it possible to obtain economically four different speeds by means of only two such motors. The object of this arrangement is to do away with some of the difficulties now experienced in applying induction motors to railway work.

As is well known the concatenated control of two induction motors consists in connecting the secondary circuit of one to the primary of the other, mechanical connection being arranged so as to make the moving parts of both motors always run at the same speed. In this way a combination is obtained giving a speed corresponding to half of the regular speed of each motor. The torque of each motor will be the same when used single or in concatenated connection. This means that the output of the concatenated combination is only half of the output of the motors operating independently.

If instead of using two similar motors, two motors of different speeds (*i. e.,* with a different number of poles) are combined in concatenated connection, a speed is obtained which corresponds to a number of poles equal to the sum of both motors. Assume a combination of a 6-pole and a 4-pole motor and a frequency of 50 cycles per second; then three different speeds are possible, viz.: the speed of the 4-pole motor alone (the 6-pole motor running idle), or 1,500 r. p. m. (minus slip); the 6-pole motor speed, or 1,000 r. p. m., and the combination speed, or 600 r. p. m. If both motors are of the same horse-power, say, for instance, 50-hp, the combination gives also 50-hp. By means of this arrangement there is thus a motor capacity of 50 hp at three different speeds, 1,500, 1,000 and 600 r. p. m.

But it is possible to go still further. When connecting in concatenation there is a possibility of making the connection either so that the torque of both motors works in the same direction, or by crossing the leads combining the secondary of the first motor with the primary of the second, to get a resultant torque which is the difference between those of the two motors. This arrangement may be called a differential concatenated connection. In order to see the result of this, assume two motors, one with 10 poles and one with four poles, both of the same output, say 50 hp each, the rotors being mounted on the same shaft. (Fig. 1.) If now the source of current be connected to the stator of the 4-pole motor, and the rotor winding of the same motor be connected to the rotor winding of the 10-pole motor in such a way that the magnetic field in both rotors will revolve in the same direction relatively to their cores—then the torques of both motors will be opposite to each other.

As both motors have the same output, then if the torque of the 4-pole motor be called unity, that of the 10-pole motor will be 2.5; accordingly the resulting torque in this case will be 2.5 — 1 = 1.5, and acting in the same direction as that of the 10-pole motor. As

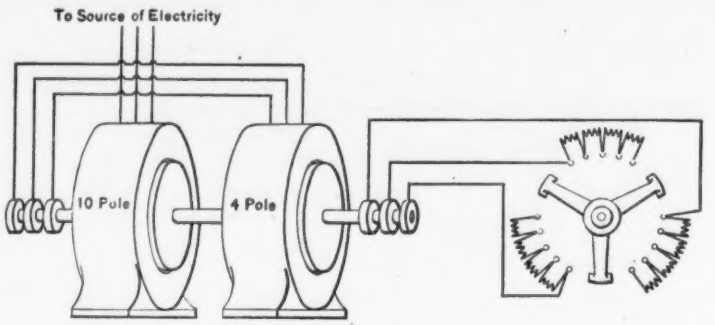


FIG. 1.—TWO ROTORS ON ONE SHAFT.

the system begins to move, the frequency in the circuit belonging to the rotors increases, whereas the frequency in the stator of the 10-pole motor decreases. Started in the regular way by inserting resistance in the last secondary and gradually cutting it out, the speed comes up until the frequency in the stator winding of the 10-pole motor approaches zero, which will happen when the speed is 1,000 r. p. m. (the frequency being 50 cycles per second); that is to say we have obtained a motor running at 1,000 revolutions, and with a torque which is represented by 1.5; the torque of a 1,500 revolution motor (4-pole) of 50 hp being unity. Accordingly, the horse-power of this arrangement is still 50.

By means of this combination of two motors we can thus obtain the same output under following conditions: (1) The 4-pole motor alone, the 10-pole running idle with a speed of 1,500 r. p. m. (2) Differential concatenation speed, or 1,000 r. p. m. (3) 10-pole motor alone, the 4-pole motor running idle, or a speed of 600 r. p. m. (4) Regular or direct concatenation of speed of 428 r. p. m. These torques and speeds are graphically represented in Fig. 2, which gives the torque for any of the speeds with regular full load current on a 20-hp motor. The lag, of course, is considerably greater in the con-

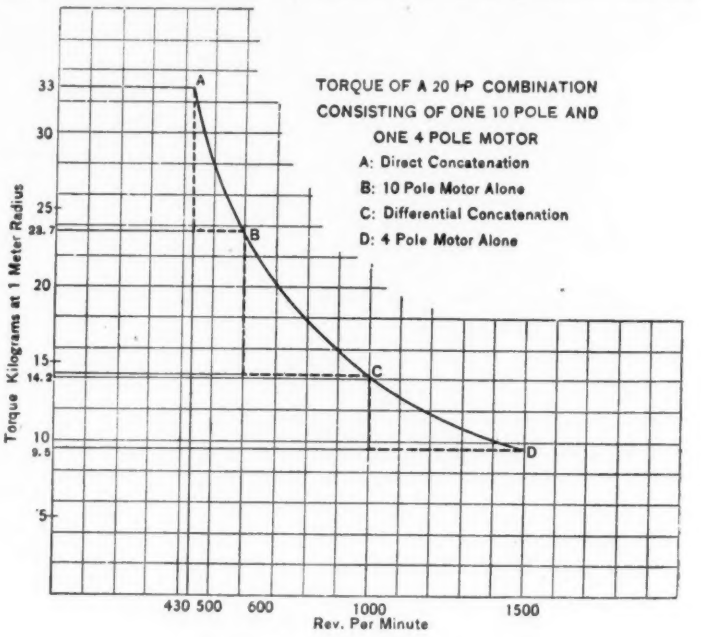


FIG. 2.—TORQUE AND SPEED OF 200-HP MOTOR.

catenated connection—direct or differential—than with one motor alone.

Fig. 3 shows a small motor built on these principles and which is intended for running tool machinery in a workshop. It is designed with a 10 poles of large diameter on one side and 4 poles on the other side. It accordingly gives the speeds 428, 600, 1000, 1,500.

Obviously, if gearing of some kind be used, the motors need not have different numbers of poles. For instance, if both motors are identical and are geared to the same shaft so that one gives a speed

.617 that of the other, then the speeds which are obtainable form a geometrical series, the ratio of which is 0.617; that is to say, it is possible to obtain four different speeds each of which is 0.617 of the one which is next higher.

Referring to the fact first brought forth by Mr. Steinmetz, that a system of two equal induction motors in concatenated connection

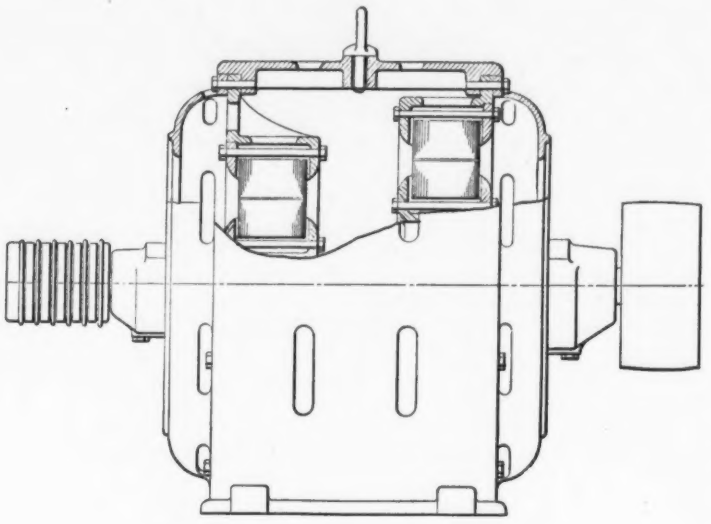


FIG. 3.—DIAGRAM OF SMALL MOTOR.

can operate at two different speeds, Mr. Danielson says that in this case there is no risk of obtaining the secondary speed instead of the one desired, for the reason that the latter speed is always lower than the secondary speed.

Among the advantages given for this system as applied to electric traction work is the possibility of using economically four different speeds. When running over a road with considerable grade, the motors can work at different torques, corresponding to the different speeds, and still have the same input, which is not the case with the series motor; moreover, it is possible over almost the entire range to increase the torque above the normal if that should be considered desirable—for instance, in order to make up for lost time. This is shown graphically in Fig. 4, which shows a curve of torque and speed

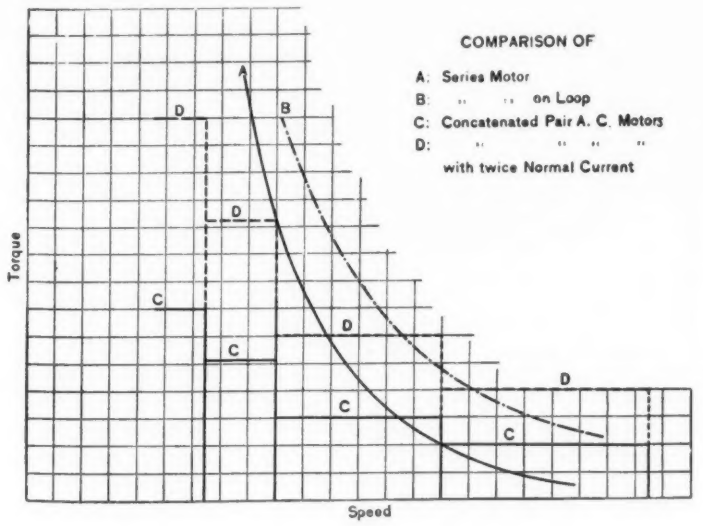


FIG. 4.—CURVE OF TORQUE AND SPEED OF SERIES MOTOR.

for a series motor and for a combination of polyphase motors. While the direct-current motor cannot at higher speeds develop torque above the curve, the induction motors can momentarily develop anything up to the dotted line.

In using this system the work of the motorman will consist merely in handling the controller so as to keep the current at a certain normal value, not only when accelerating, but also when running. As to economy, the accompanying table gives a comparison of the different systems with respect to input, the motors starting up to full speed and braking down, electrically, as far as possible.

RELATIVE AMOUNT OF EENRGY CONSUMED.

	Accelerating only.		Accelerating and Braking Electrically.	
	Without gearing.	With gearing.	Without gearing.	With gearing.
D. C. Motor, resistance entirely cut out at ⅔ full speed	1.33	1.4	1.33	1.4
D. C. Motor, resistance entirely cut out at ¾ full speed	1.4	1.48	1.4	1.48
A. C. Motor, simple	2.17	2.29	2.17	2.29
A. C. Motors regular concatenated connection	1.68	1.77	1.36	1.47
A. C. Motors, three speeds: 0.4: 0.67:1	1.5	1.58	1.17	1.27
A. C. Motors, four speeds: 0.285: 0.4:0.67:1	1.45	1.52	1.15	1.24

Mr. Danielson says that, admitting the polyphase motor as a rule is fully as efficient as the series direct-current motor, it may be considered that when working on an even road the difference in energy consumption will be negligible; it would then appear that by using the four-speed arrangement of concatenated connection, it will be possible to get a more economical method of working electric roads than by means of the direct-current system with series motor. Considering at the same time that for greater distances the electric energy has to be generated as alternating current and then transformed into direct in converter stations, whereas with polyphase motors on the cars simple transformers can be used, giving a difference in loss of at least 5 per cent. to 7 per cent. in favor of the alternating-current motors, the comparison comes out still more in favor of these. Another advantage is that there is no need for high voltage in the rotating parts of the motors; the rotor windings can be arranged for any desired voltage, thus giving the designer full liberty to choose this so as to get the most convenient winding.

As to any difficulty introduced by making one of the motors of 2.5 times the torque of the other, the author replies that the best solution probably in many cases will be to connect in concatenation one motor with two or three others in parallel—for instance, with a locomotive with four axles, have three of the motors of a slower running type than the fourth, and of a current-carrying capacity something like one-third of the latter. The same arrangement could be used for an ordinary double track car with four motors. For cars with only two axles the best arrangement will probably be with only three speed connection, and then there will be very little difficulty—the difference in torque of the two motors not being so considerable.

The discussion of the two papers read was opened by President Steinmetz, who briefly abstracted Mr. Danielson's paper, and said, in closing, that he considered it a very fair comparison of the relative merits of alternating and direct currents for railway work. He then called upon Mr. C. O. Mailloux to open the discussion.

Mr. Mailloux stated that although upon returning from Europe a few years ago he had been completely saturated with the alternating-current idea, he had since become demagnetized and now considered there were too many limitations in the possibilities of high acceleration in alternating-current railway motors to make them practical for ordinary service. He pointed out that in Mr. De Muralt's paper the accelerations were only from one-half mile per hour, per second, to three-quarters mile per hour, per second, which rates are very much under the requirements of passenger service in this country. He thought, however, that the alternating-current motor would find its place when long roads operating under essentially steam railroad conditions commenced to be electrified. In the present state of the art, he believed, passenger service dictated the use of direct-current motors. He called attention to the importance of Mr. Danielson's paper, as indicating the possibilities of better control than is now obtained by ordinary arrangements of alternating-current equipments. On account of the weight increasing so rapidly with increased power, and the necessity for having much larger motors for accelerating than are required for running, he thought, with present designs, it would be economically possible to obtain high acceleration only by the use of special gearing with changeable ratio between motor shaft and driving axle.

Mr. Steinmetz continued the discussion by commenting on the power used on the Swiss roads. Comparing it with the consumption of an ordinary American interurban car, it appears very small. While the tests showed that the motors could be slightly overloaded, he thought that not enough margin was left. Ordinary requirements demand that a motor car should be able to push a disabled car in front

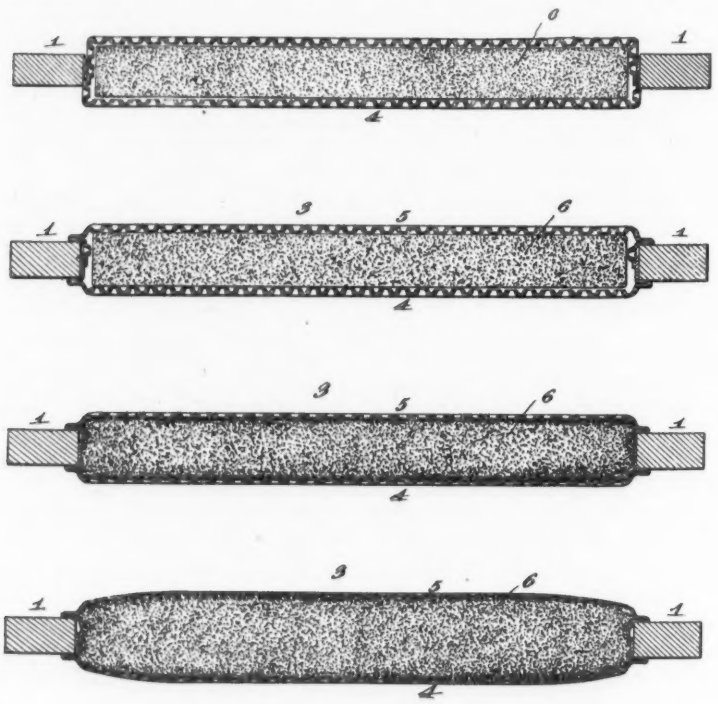
of it, involving an overload of over 100 per cent. As the motors could not be run above synchronism, the old trouble of the cable roads in not being able to make up time was again present. As power was returned to the line only when motors were running above their nominal speed, it would be dangerous to attempt it with passenger cars designed for 40 miles per hour, although much saving may be effected in this way with slow speed freight trains.

The discussion was continued by Messrs. Stott, Hammer, Walcott, Henshaw and others. In replying to numerous questions that had been asked, Mr. De Muralt said that there had been no trouble from short-circuiting on three-phase, 10,000-volt trolley lines when placed one above the other. An arc had never started as the contact device was good and the current low. It was necessary to have the substations near together on heavy-duty lines alone. The lighting arresters used had given no trouble as far as he knew. The distance between the top of cars and trolley wires where the bow trolleys were used made little difference, but best results were obtained when the trolley was nearly vertical. The rollers had variable lengths of life, some lasting much longer than others. It is no trouble to renew a roller, and the old one is recast with slight loss of material. The tubes are made of softer metal than the trolley wire, and so take most of the wear. The use of the iron rails as one leg produces no unbalancing of the three-phase circuits. It is probably prevented by the high frequency used. He thought the ability to make up time did not belong entirely to direct-current motors. Where loss of time occurs from too long or frequent stops, it generally is accompanied by an overload of passengers. Under such conditions the alternating-current motor may make better time than an overloaded direct-current motor. He thought acceleration a matter of motor capacity. An acceleration of 1½ miles per hour, per second, have been obtained, and he thought motors could be designed for even greater accelerations.

Recent Developments in Electrochemistry.

By CLINTON PAUL TOWNSEND.

Mr. Edison has stated that so far as regards capacity per unit of weight, the most effective combination, in an alkaline solution, is finely divided iron against nickel or cobalt oxide, both mixed with foliated graphite. This statement lends interest to



FIGS. 1 TO 4.—EDISON BATTERY.

his current patent disclosing an economical method for the production of the iron in suitable physical state. As will be recalled, the method patented a year ago depended upon the electrolytic oxidation of ferrous sulphide in potassium hydrate, and subsequent reduction of the oxide formed; according to the present disclosure, sheets of the purest Norway iron are subjected to quick oxidation in a muffle, and the scale at once detached and ground to pass through a 200-mesh sieve. This scale oxide is mixed with one-fourth its weight of foliated graphite, packed in the pockets of the plate, and electrolytically reduced.

In another patent Mr. Edison describes in detail the construction of the plates. These are of the now familiar form, comprising a light framework of nickel-plated steel, the active mass being retained in perforated pockets, also of plated steel, secured in the apertures, and the upper bar of the grid increasing in cross section toward the connecting lug in conformity to the rate of discharge from the pockets. The changes undergone during forming are well shown in the accompanying figures, in which the grid is indicated at 1, the perforated pockets at 3, and the active mass at 6. Opposite plates 4, 5, enclosing the active mass, are set in position in the grid, as indicated in Fig. 1. A compression of the ends crimps the pockets over the grid, as shown in Fig. 2. Upon immersion in the alkaline electrolyte the active mass increases somewhat in bulk, bringing it, as shown in Fig. 3, into close contact with the pockets; and upon forming a further increase in bulk occurs, distending the pocket walls, as shown in Fig. 4. Thereafter the elasticity of the steel walls is relied upon to maintain a close contact through the changes of bulk undergone during successive charges and discharges.

OXYCHLORIDES.

Mr. George Jones Atkins, of London, England, patents the device illustrated in Fig. 5, comprising a vessel *a* lined with carbon blocks

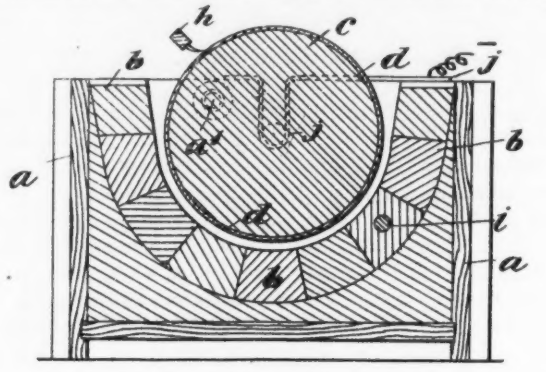


FIG. 5.—CHLORINE ELECTROLYSIS.

b and supporting a revoluble cylinder *c* of wood covered with a sheet *d* of lead. The carbon blocks and the sheet-lead cylinder constitute anode and cathode respectively, the electrical connections being indicated at *i j*. Sodium chloride solution is introduced at a^1, and passing through the annular space between the electrodes overflows at the opposite end of the bath. A scraper *h*, bearing on the revolving cylinder, mechanically depolarizes the cathode. A solution of sodium chloride flowing through the vat is decomposed by a current of less than four volts, yielding a mixture of chloride, hypochlorite and chlorate, which in the presence of acid may be used for the slow liberation of chlorine, for the treatment of ores or other purposes. Save for the single feature of the direction of flow of the electrolyte, the apparatus is identical with that patented many years ago by Hermite for the electrolytic production of bleach liquor.

ELECTRIC FURNACE.

A patent issued in the name of the late Dr. de Chalmot covers the furnace employed by him for his well-known researches on the metallic silicides. The furnace comprises the usual carbon-lined, cast-iron pot *A*, formed in two sections, *a*, *b*, with an intermediate flange *c*, *g*, and provided with the tap *d* and vent *e*. This pot forms one electrode, the other being the carbon *B* depending through the cover. The distinctive features are the sectional construction of the cover *m*, m^1, clearly shown in the figure (page 911), with independent water conduits to each section; the stuffing-box *E*, to prevent access of air to the heated carbon; and a shunt *s* from the electrode to the cover, whereby these portions of the furnace are maintained at the same potential. This is an important feature, since an accidental arc to the water-cooled cover would destroy it. A line of insulation *l* prevents short circuiting between the cover and the pot.

FUSED BATH ELECTROLYSIS.

Messrs. Roepper & Scholl, of Philadelphia, describe apparatus for the electrolysis of fused baths in general, the essential feature being the provision of a fusion chamber adjoining the electrolytic cell.

this chamber and the cell communicating at their lower portions. The purposes are to utilize gases of combustion for bringing the salts into fusion and to provide means for free communication between the general body of fused salt and the particular portion undergoing electrolysis. The details of the electrolytic cell have been carefully worked out, the several parts being water cooled and

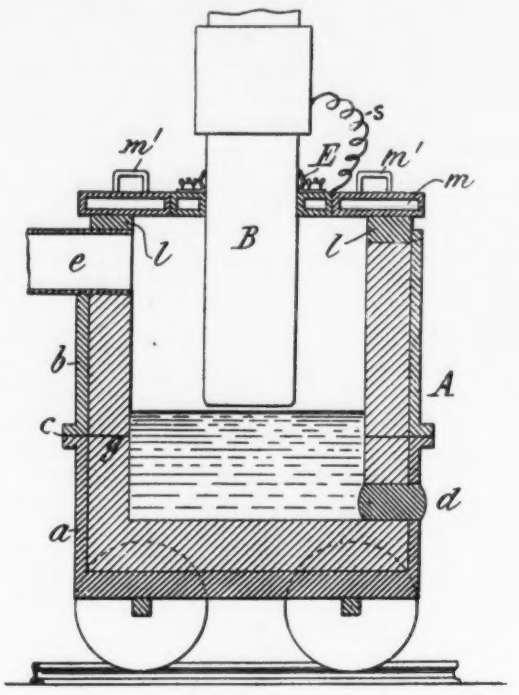


FIG. 6.—DE CHALMOT'S ELECTRIC FURNACE.

readily replaceable, and the principle of protection by a chilled layer of electrolyte being freely applied.

REDUCTION OF ORES.

Mr. Frederic H. Long, of Chicago, has heretofore patented a "converter," wherein a stream of ore pulp is continously circulated past the anodes and over the horizontal diaphragm of an electrolytic cell, the cathode compartment comprising a chamber beneath the diaphragm. He finds that in operation the resistance rises owing to the accumulation of gas below the diaphragm and bases his present patent upon the simple expedient of providing a suitable vent pipe at the proper point. Carmichael long ago found the same difficulty and solved it in the same way.

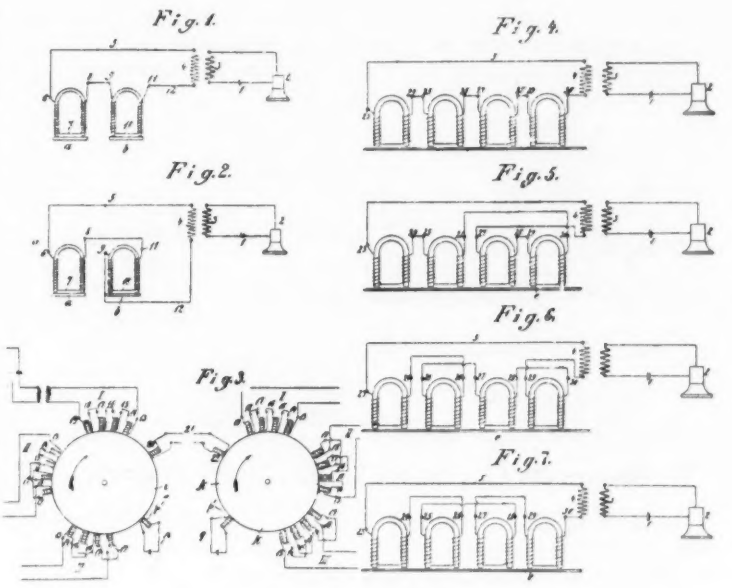
Multiplexing the Telegraphone.

A patent just issued to Peder Oluf Pedersen, of Copenhagen, covers a method of using the Poulsen telegraphone in such a way as to record a number of messages on a single steel strip and to reproduce each message without interference from the other. With this improvement in the Poulsen invention, it is obvious that the size of the drum or the length of the wire or ribbon used therein may be materially lessened, so that a long speech or a number of speeches or signals may be stored upon a comparatively short or small magnetic body.

The essence of the invention is the use of two or more recording magnets, the connections of which are varied for each message, with a corresponding variation in the combined action of the magnets on the recording strip. To reproduce each message the connections of the magnets must be adjusted to the same combination that was used in impressing it. In the drawings, Figs. 1 and 2 show how two messages may be recorded on and reproduced from the same portions of two adjacent steel strips. Fig. 3 is a diagram showing how several messages may be simultaneously transmitted over a single line by means of the telegraphone; and Figs. 4 to 7 illustrate the methods of connecting four electromagnets in different ways to fix four different messages on the same strip. In Figs. 1 and 2, *a* and *b* are two separate steel ribbons drawn past the poles of magnets 7 and 10 connected in series with the secondary 4 of the telephone circuit. By means of plugs 6, 8, 9 and 11 the connections of the magnets in the circuit may be varied. A message spoken into the transmitter 2 will be recorded magnetically on the strips *a* and *b*, and may be reproduced on substituting a receiver for coil 4, according to the well-known action of the telegraphone.

By changing the connections of the magnets, as shown in Fig 2, the polarity of one is reversed and in this state of the magnets the original message cannot be reproduced, because each magnetic condition in one of the strips *a* and *b* will be equal to the corresponding condition in the other, and as they oppose each other in the magnets there will be no current in the circuit and silence in the receiver; but while the magnets are thus connected it is possible to fix on *a* and *b* an entirely new message, which will not in any way obliterate the first message, and which can be reproduced while the connections remain the same and will not prevent the reproduction of the first message when the connections of the magnets are changed back to the conditions shown in Fig. 1. It is not necessary to use separate recording strips for each magnet, as the desired results can be obtained by using a single strip, it being necessary only that the magnets shall act at different parts of the strip. In using a drum carrying a spirally-wound steel wire, the magnets should be arranged to bear on two different convolutions of the spiral.

Figs. 4 to 7 show the extension of the method to four magnets, the connections of which can be varied, as indicated, to permit the recording and reproduction of four separate messages on the same strip. Fig. 3 shows the application of the same principle of varying combinations of magnets to the simultaneous transmission of several messages along the same wire. It is assumed that three messages are to be simultaneously transmitted along the line 21. At the transmitting end is a steel disk *i*, and at the receiving end a similar steel disk *k*; in working both are simultaneously rotated. Each station has three local circuits, *I, II, III,* each having four electromagnets connected in different combinations, the combinations of the different circuits at each end corresponding with each other; that is, the magnets of each circuit *I* are connected in the same manner, and so on. The circuit 21 is connected at each end to an electromagnet, 20 and 22, facing the corresponding disk. With the apparatus equipped thus in operation, the magnetism created in the disk *i* by the three different sets of magnets acting simultaneously thereon



PEDERSEN'S MESSAGE RECORDER.

will affect the magnet 20 and send impulses over the circuit 21, which will be received by 22 and impressed upon the disk *K*.

Those impulses which were created by the circuit *I* at the transmitting end will be picked up and delivered to the receiver in the circuit *I* at the receiving end, and in like manner the receiving circuits *II* and *III* will select the messages delivered through the circuits *II* and *III* at the transmitting station. After the disk has passed all the recording and receiving magnets it passes an obliterating magnet p^1, which cleans off the record so that it may be presented to the recording magnets in condition to receive a new portion of the message.

New Telephone Patents.

The issue of the Patent Office, of May 13, contains little of interest to telephone men, there being but two patents directly bearing on telephony. The first is due to Mr. Frank B. Cook, of Chicago, and covers a polarized bell of somewhat novel design. Mr. Cook entitles his invention, a "polarized electromagnetic apparatus," and does not wish to confine its application to bells, though a polarized bell is what he specifically describes. The general design of the bell is somewhat similar to that of the drop patented by the same inventor a short time ago, the magnet being enclosed in a split casing between the opposed ends of which the armature is pivoted. The magnetic casing surrounding the magnet core besides providing a sensitive magnet gives the magnet a high impedance, and also serves as a protection against fire by enclosing the coil in a fire-proof sheath.

Referring to Fig. 1, A and A^2 are the permanent magnets attached to the frame D^3 by the bracket D^2 and supporting the two parts B and B^2 of the magnetic shell or casing of the electromagnet D by means of the screws a a. The core D^4 of the electromagnet is connected to the two parts of the shell B and B^2, so that the core, the shell and the armature form a nearly complete magnetic circuit. The ring armature H is pivoted as shown at b, and encircles the electromagnet D. The armature is, therefore, disposed between the ends of the two parts B and B^2 of the shell, so that the polarized ends thereof act directly upon the armature. The usual bell-hammer J is attached to the armature.

With an alternating current the ends of the two parts of the shell are of different polarities, and a combined push and pull is brought to bear upon the armature. The ends of the permanent magnet, also brought to bear upon the armature H, are of the same relative polarity, thus permanently polarizing the armature with one magnetic polarity.

The upper sketch, to the right in the illustration, shows an attachment to be used when a straight current is employed, which is capable of ready attachment to or detachment from the bell. It consists of a prolongation or extension piece, K, of the armature, a bracket, K^2, removably held on the permanent magnets by the screws a a, having a holding arm K^3, a spring K^4 and an adjusting screw K^5 for the spring. This device is capable of ready removal, and can be reversed in position as desired to exert an opposite pull on the armature when a current of opposite polarity is used.

The inventor claims that as the lines of force of the magnet poles

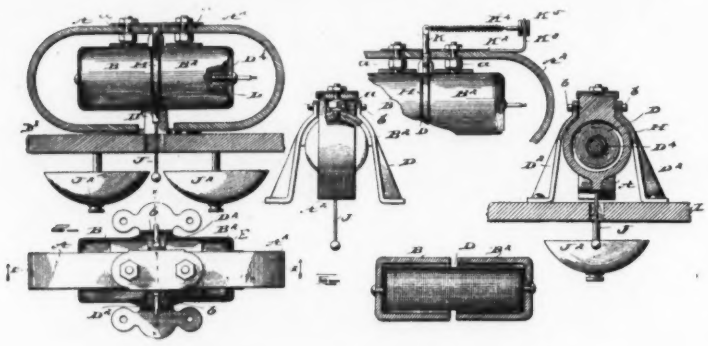


FIG. 1.—COOK'S POLARIZED ELECTROMAGNETIC APPARATUS.

of the shell act directly upon the armature, the arrangement is such as to produce a more sensitive action of the armature, while the inclosing of the magnet coil in a magnetic shell gives a high impedance without the use of excessively long cores.

Mr. George E. Goodhead, of Winchester, Illinois, patents a telephone circuit for party-lines, the object of which is to provide means to prevent intermediate stations from listening in. The device embodies the use of an auxiliary switch, more or less controlled by the receiver switch hook, and is one of the many arrangements of circuits and apparatus that go through the Patent Office, but seldom reach the field of practical application. Fig. 2 sufficiently illustrates the idea. An auxiliary switch consists of contact plates 4 and 5, between which and adapted to engage with either is plate 6, mounted on block 7 of insulating material, and moved by rod 8, having the slotted end 9, in which the receiver hook works. The parts of the switch are also shown in detail, as well as the slotted end of the rod, the end of which is bent out so that it may be moved by hand. The line wire 9 comes from central, and is continued on to the next station by wire 11, wire 12 being a common return; or rather, the stations are connected in series with a branch to the common return. Moving the receiver off the hook 3 cuts off the wire 11, and moving the push-rod 8 upward cuts off line 9 from the station and connects

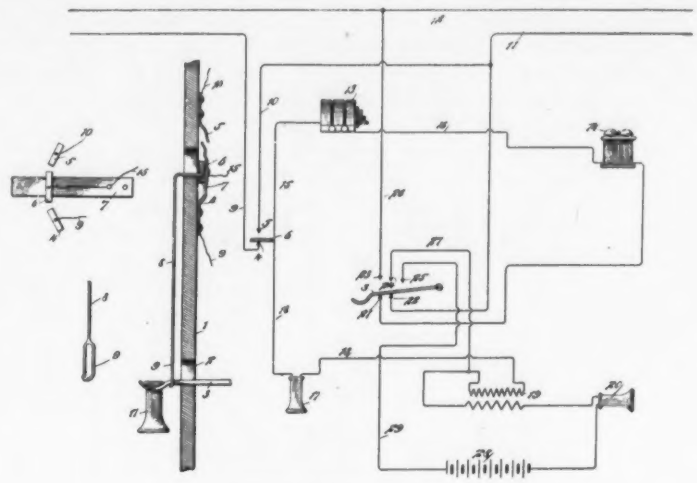


FIG. 2.—GOODHEAD'S TELEPHONE CIRCUIT.

line 11 by means of wire 10. Upon replacing receiver 17, the rod 8 will be drawn down, thus automatically restoring the circuit. An intermediate telephone attempting to listen in cuts out the station on the side away from the central by breaking the connection between wires 9 and 11 at contacts 21 and 22.

CURRENT NEWS AND NOTES.

AUTOMOBILE CHARGING STATIONS.—Stations for charging automobiles using the "Exide" battery have been opened in New York, at 148 West Eighteenth Street; Philadelphia, at 250 North Broad Street; Buffalo, at 200 Pearl Street; Chicago, at 264 Michigan Avenue. Similar stations will shortly be established in a number of other cities.

FRENCH SUBMARINE BOATS.—A cable dispatch from Paris says: M. Goubet, the inventor of a submarine vessel, who is not an officer, disgusted over the tactics of the regular officers of the navy, who through their alleged jealousy caused him all sorts of trouble, has sold his invention to an English private company, specially organized to build the vessel. Goubet received $100,000 in cash, retaining a third interest of the future profits. The company will build indiscriminately for governments or private persons.

A. A. A. S.—The preliminary announcement of the meeting of the American Association for the Advancement of Science, to be held at Pittsburg from June 28 to July 3, fills 50 pages of an octavo pamphlet, just issued. Full information is given concerning railroad rates, and a list is printed of the names of all of the officials for the Pittsburg meeting and of the local committee, the latter comprising several hundred names. Some pages are devoted to information concerning the hotels and boarding houses of Pittsburg, and the arrangements made for the places of meeting of the various sections of the association and of the affiliated scientific societies. A guide to Pittsburg occupies ten pages, in which information is given concerning the various places of interest, with directions as to transportation to the same. Arrangements have been made whereby representatives of the press may have full facilities for reporting the meeting. The importance of properly reporting the meetings of the association is dwelt upon by the secretary, and members are urgently requested to bring to the meeting duplicate type-written abstracts, or reports, stating the main features or facts contained in the papers. With the admirable arrangements that have been made for the meetings of the association and the entertainment of the visitors, and with the facilities that will be accorded newspaper men, the Pittsburg meeting of the Association promises to be one of the most successful—perhaps the most successful—in the history of the association.

DIGEST OF PATENTS.—Mr. Jas. T. Allen, well known as an authority on electrical patents, is engaged on the preparation of a digest of telephone patents from the earliest patent to December, 1901, and on similar digests of electric lighting patents, automobile patents, and air and gas engine patents.

ELECTRICAL ENTERPRISES IN WALES.—The U. S. Consul at Cardiff, Wales, reports that much interest is being taken in what promises to be the most gigantic enterprise in the principality—the South Wales Electrical Distribution Company, which is building a large generating station at Pontypridd. The station, when completed, will generate no less than 70,000 horse-power, and no one unit will be smaller than 3,000 indicated hp. At present, five combined sets of triple-expansion engines and generators, together with 24 water-tube boilers, and all the necessary auxiliary machinery, switchboards, mains, etc., are being provided for, and will be at work within 12 months from the present time. Three-phase currents will be generated at 12,000 volts.

FROGS AND TELEGRAPHS.—Something new in the relations between "galvanic" telegraphs and frogs is reported as follows: One of the great enemies of the overland telegraph line in central Australia is the common green frog. In order to save the insulators from being broken by the lightning they are provided with wire "droppers" leading round them at a little distance, to conduct on to the iron pole in case of need. The frogs climb the poles and find the insulators cool and pleasant to their bodies, and fancy that the "dropper" is put there to furnish them with a back seat. After a nap they yawn and stretch out a leg until it touches the pole—result, sudden death of the frog, and as the body continues to conduct the current to earth we have a paragraph in the papers to the effect that "in consequence of an interruption to the lines, probably caused by a cyclonic disturbance in the interior, we are unable to present our readers with the usual cables from England."

BIRKELAND ELECTRIC CANNON.—A cable dispatch from Berlin, of May 17, says: It is announced that the trials of the electromagnetic cannon, invented by Prof. Birkeland, of Christiania, has been so successful that a German firm has offered to purchase the system. The proposal will be placed before a company which has been formed at Christiania for the development and improvement of the invention. In the meantime, arrangements are on foot to test the power of the gun to fire a projectile of two tons a distance of 12½ miles, which the inventor asserts it can do. The Norwegian company, however, has not been able to raise the £7,500 necessary to carry on the test. The Norwegian experts are confident that this cannon will effect a revolution equal to that caused by the invention of gunpowder. According to Prof. Birkeland's calculations, the firing capacity of a cannon increases with the length of the barrel. A gun with a barrel of 32 feet 10 inches could fire a two-ton projectile 93 miles, which would enable the French to bombard London from Calais. A longer barrel ought to be able to hit the moon. It would be interesting to have the Professor's calculations as to the kilowatt capacity required for his gun, and the amount of material for electromagnetic storage.

SAFETY ELECTRIC RAILWAY SYSTEM.—Five patents issued May 13, to Charles J. Kintner, relate to arrangements having for their object to prevent front or rear-end collisions between electric cars operated on a sectional conductor system. The essential feature of the system patented lies in connecting each sectional conductor to the earth or return circuit through a releasing and signalling circuit running to the distant ends of the two adjoining sectional conductors. The application of this principle makes it possible to avoid either front or rear-end collisions, to avoid accidents at turnbridges, at sidings, at crossings at other roads, whether electrical or common roadways, and a number of other essential dangers. One of the patents relates to means for using metal terminals for connecting the sectional conductors to, and disconnecting them from, the current feeder or main without arcing, and the placing of such terminals in relatively close position to each other. The sectional conductors are by this system locked into connection with the current feeder as a car enters a section and remain locked until the car either advances and passes out at the other end of the section, or runs backward with reversed trolley to the distant end of the sectional conductor it has just left.

TELEPHONE RECEIVER FOR WIRELESS TELEGRAPHY.—The name of "coherer telephone" has been given to a wireless telegraph receiver by the inventor, Thomas Tomasina, of Geneva, Switzerland. There is a coherer in connection with the diaphragm of a telephone receiver, the terminals of the coherer being connected, respectively, to the antennæ and to ground. These terminals also serve to connect a relay circuit. When the relay circuit is closed through the coherer by the Hertzian rays passing through the same from the antennæ to ground, the second circuit is closed in turn by the relay to operate the recording apparatus and energize the diaphragm magnet, thus producing a sound, and at the same time decohering the material of the coherer. The sound produced by the receiving instrument is stated to be sufficiently loud to be heard distinctly without placing the instrument to the ear, and hence in use it is not necessary to remove the instrument from its support. The iron diaphragm of the ordinary telephone receiver is covered on one face with a sheet of insulating material, such as paper, on which is fixed, by means of a second sheet of paper, a plate of insulating material having an opening, which forms a recess in which the cohering powder is lodged. A sheet of mica closes this recess and allows the cohering powder to be observed. The movement of the diaphragm of the electromagnet gives the necessary mechanical decohering motion to the powder.

ANNUAL MEETING OF THE A. I. E. E.—The Nineteenth Annual meeting of the American Institute of Electrical Engineers was held at New York on Tuesday, May 20th, president Steinmetz in the chair, 75 members and guests being present, and 149 members represented by proxy. The annual reports of the Board of Directors and the Treasurer were presented, showing a net gain in membership of 239 during the year, and an increase of $14,844.48 in net assets, the total assets on May 1st being $30,220.24, of which $1,885.17 is in cash, and $16,285 in government bonds (market value). The president appointed Mr. Townsend Wolcott, Col. Samuel Reber and Mr. W. C. Andrews a committee on proxies. Chairman W. J. Hammer of the committee on tellers reported the election by ballot of the nominees of the Board of Directors of officers for the ensuing year as follows: President, Charles F. Scott. Vice-Presidents, C. O. Mailloux, Bion J. Arnold, Schuyler S. Wheeler. Managers, Townsend Wolcott, Gano S. Dunn, E. H. Mullin and Charles A. Terry. Treasurer, George A. Hamilton. Secretary, Ralph W. Pope. Under the Constitution the following officers hold over: Vice-Presidents, Dr. Michael I. Pupin, Dr. Samuel Sheldon and George F. Sever. Managers, John J. Carty, W. S. Barstow, Ralph D. Mershon, Calvin W. Rice, John W. Leib, Jr., W. E. Goldsborough and Col. Samuel Reber. Mr. Carl L. deMuralt then read a paper on "Some Notes on European Traction with Three-Phase Alternating Currents," which was fully illustrated by lantern slides. An abstract of this paper will appear later in these columns. A paper by Mr. Ernst Danielson on "A Novel Combination of Polyphase Motors for Traction Purposes," in the absence of the author, was read by the president. An abstract of this paper and the following discussion is printed elsewhere in this issue. At the meeting of the Board of Directors in the afternoon 34 associate members were elected.

LETTERS TO THE EDITORS.

The Telegraph of To-day.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to Prof. Pupin's criticism of the Western Union Telegraph Company for its alleged slowness in adopting new methods, I am constrained to say that the professor displays a wonderful lack of knowledge of the telegraph, which is perhaps not surprising in view of the fact that the gentleman has presumably had no practical experience whatever in this field. For the benefit of those who read Prof. Pupin's criticism and are unfamiliar with the practical workings of the telegraph, I take pleasure in making reply to the criticism from a practical standpoint.

At the time when Prof. Morse erected his first wire between Washington and Baltimore, a distance of 41 miles, under adverse circumstances, and over which he sent his first message, he did not realize that he had invented the best, quickest and cheapest system of telegraphy that has been introduced up to the present time. It is true that this first message was reproduced embossed on paper, by means of what was then known as the receiving register. This

method of receiving telegrams was in vogue for a number of years, until the young American with his quick ear for music learned to receive messages by sound; the old registers have long since become obsolete, and with nimble fingers, messages are now transmitted over the wires not only a distance of 41 miles, but thousands of miles, as rapidly as the receiver can write them on a type-writer, and as distinctly and simple as *A, B, C*—I may say more distinctly than the letters and figures can be talked over the telephone lines, for there is no similarity between the Morse characters forming the letters *B* and *V* and other letters, which letters are so confusing when transmitted over the telephone.

Since the telegraph was invented, the improvements in the apparatus have kept apace with the demands of the American people, and to-day, according to the admissions of experts who have been sent here by all the foreign countries to investigate our systems, the telegraph systems in America are years in advance of those of most all other nations. This is evident in the improved apparatus, namely, the multiplex systems, automatic repeaters, switchboards, copper line wires, insulation and conductivity, motor-dynamos, storage batteries, etc. To illustrate the quickness of this wonderful system, it is not uncommon for a broker to file his message in New York, Boston, Chicago, Philadelphia or other cities in the United States, and to have the same transmitted to his broker on the floor of one of the exchanges, the order filled, and to have received the reply notifying him that it had been executed, within the short space of 55 seconds. Messages of this description are not only transmitted between Chicago and New York, a distance of 984 miles, but the same is true of the direct working wires of this company between San Francisco and New York, a distance of 3300 miles. The American people have been educated up to this quick service, which, as I have said before, is the most rapid that has been introduced up to the present time.

Prof. Pupin referred particularly to the automatic rapid system of telegraphy, and in order to compare one of these systems with the former, it will be necessary to explain the *modus operandi* necessary to transmit and receive a message. I may say that one of the most rapid systems was given a practical test by the writer over the Western Union lines between New York and Chicago within the past two years, and in point of working satisfactorily it was an absolute failure, and not adaptable to use in this country on account of its slowness. In the system referred to, the message when handed into the office of the telegraph company is placed before an employé known as a "puncher," who perforates the message on a strip of paper, which consumes more time than would be required by an expert operator to transmit it from New York to San Francisco by the Morse system. The message is afterwards run through what is known as a Wheatstone transmitter; simultaneously a receiver is in operation at the distant end of the line, consisting of a cylinder containing sensitized paper. After the message has been reproduced on this paper, it is necessary to carry it into a dark room, where it is developed in the same manner that a photographer develops his negative. It is next placed in the hands of an employé known as a "copyist." The message is then copied on a type-writer, which again consumes more time than it would require an expert telegrapher to receive the message transmitted by the Morse system.

If an error is discovered in the message as received on the sensitized paper, which frequently occurs, it is not possible to correct it at the time it is being received, as would be the case if telegraphed by the Morse system, and much time is consumed in making such corrections.

A number of automatic systems have been tested by the telegraph companies of this country, but up to the present time every one of them has been found lacking, except for emergency service. They are not only slower than the Morse system, but more expensive to operate. A corps of expert electricians is constantly in our employ experimenting with new devices and testing automatic and machine telegraphic systems, with a view to securing something better than the Morse. While some of the automatics will transmit very rapidly, the time wasted in preparing the message for transmission and recopying makes the service slower and more expensive than the Morse.

To show the growth of the Western Union Telegraph Company, in 1867 it operated 46,000 miles of poles and cables, 85,000 miles of wire, and handled 5,000,000 messages with 2,000 offices. In 1901 it operated 194,000 miles of poles and cables, 973,000 miles of wire, and handled 66,000,000 messages with 23,000 offices. The greatest length of one continuous circuit operated by this company is from New York to San Francisco, 3,300 miles. The longest telephone circuit operated by the telephone company is from New York to Omaha, 1,466 miles.

NEW YORK, N. Y. J. C. BARCLAY,
Electrical Engineer Western Union Telegraph Company.

The Right of Inventors to Encouragement.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the editorial in your issue of May 10th, on the "Western Union Shakeup," I commend to prayerful consideration the remark of Prof. Pupin, "that anyone who offers them an improvement is treated like a book agent," as text for a short sermon on unprogressiveness by manufacturers in general, and especially by governments. The treatment of inventors by government officials is a well-known scandal since the days of Dickens and "Little Dorrit." In the forty years since that work was written, governmental methods (and some manufacturers' methods) have changed but little. I speak with knowledge when I say that the attitude of the United States officials is one of intolerance and obstruction. A common stock phrase among the officers to whom less fortunate inventors are referred is, "Oh, send him an inventor's letter!" It is unusual for any inquiry whatever to be made. This was the experience of those controlling the art of wireless telegraphy as commercially applied; has been the experience of many persons who have made improvements in marine engines, and has been the experience of every man who has invented an improvement in firearms, big or little; and to the shame of our government be it said, inventors have been robbed, absolutely without recourse.

To cite a concrete instance, the well-known Krag-Jorgensen gun is but a minor and unimportant modification of a weapon invented by an American, and patented by him. In the opinion of many experts, the modification was not an improvement; but, waiving this, the United States have appropriated the patented construction, and, although retaining from the purchase price a portion nominally for the purpose of guarding against claims for infringement (showing that the officers of the government were aware of the facts), no part of it has ever reached the true inventor, or is likely to do so, there being no jurisdiction in any court to try such a case, and no officer of the government having moral courage enough to demand that the contractors shall compensate the patentee. This is but one instance of many.

Dr. Conan Doyle's recent experience with the British war office, of which he complains so bitterly in the London *Times*, is but another. He had, as he thought, invented a distinct improvement in sights for firearms; if anything could possibly be needed in the British service in South Africa it was that, but upon his offer to submit it to the War Office the answer was that the office "would not trouble him in the matter." As he said, it might amount to nothing, or it might be revolutionary, but the War Office would not even inquire.

Substantially all of the progress in the mechanic arts of all kinds has been effected by persons not in government employ. Of the persons employed by the government very few are competent by education or actual ability to pass upon the value of improvements, and those few have but little, if anything, to do with the subject. This is the attitude also of some manufacturers; but is not the case with those who have attained the greatest eminence in their respective lines. To cite the case of only one large corporation, with the affairs of which I am familiar: Its entire force is constantly upon the lookout for every improvement which can be made, and it maintains a large staff of experts for the sole purpose of looking over improvements made by others which are applicable to its work, and purchasing them, either outright or the permission to employ them. Hundreds of thousands of dollars are spent in this way every year, and I betray no secret when I say that its inventors are all from two to five years ahead of present demands in the art, and constantly seeking to anticipate and provide for the demands of the new arts, and in many cases by so doing practically creating those arts.

If the American manufacturers are to get and keep the world's markets, they must of necessity resort to the improvements constantly devised by American inventors. An inventor is no longer a sporadic genius, but a hard-working business man, applying his efforts and intelligence to definite problems; in most cases a technologist, a graduate of the highest schools, versed in literature and

languages as well as in science, and very often a specialist in the particular art to which his invention relates; in many cases better qualified to pass on its value than those who have occasion to adopt it. He is entitled, no matter how visionary his plans may appear, to a fair hearing, to an opportunity to explain fully the merits of his device or process, and to have it tested on a proper scale before a decision is reached. T. J. JOHNSON.

NEW YORK CITY.

[While agreeing in the main with Mr. Johnson in his position, it should be pointed out that as a great majority of inventions do not advance beyond the stage of patent issue—often owing to lack of commercial availability, even when the invention possesses intrinsic merit in conception—there is some reason for the attitutde of the business man and government official toward the inventer.—EDS.]

Synchronous Reactance.

To the Editors of Electrical World and Engineer:

Sirs.—I have just read Mr. Behrend's letter in your issue of May 10, criticizing my article on "Synchronous Reactance," which appeared in your issue of April 26, in which he says, "it seems surprising that at this late season novelty can be claimed by Mr. Baum for discovering the discrepancy between calculation and observation in using the short-circuit current for determining the drop in alternators." I beg to say that I made no claim of discovering anything. I am aware, and have been for some years, that the short-circuit current does not give us the true reactance. In fact, no experiment is needed to prove this, and it may be considered as having been discovered at the time of the discovery of the variable reluctance of iron.

STANFORD UNIVERSITY, CALIF. F. G. BAUM.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Railway and Tramway Motors.—DODD.—A communication in which he discusses some statements made by Carus-Wilson in the discussion of Swinburne's recent paper, as has been noticed in the Digest. He corrects an incorrect statement of Carus-Wilson concerning the motor used in the test on the Liverpool Overhead. He gives in a diagram the characteristic curves of this motor. At 100 hp this motor requires 162 amp., and delivers a torque of 1,780 lbs. This is at the rate of 11 lbs. per ampere. At half-load, or 50 hp, the motor requires 83 amp., and delivers a torque of 600 lbs., or 7.22 lbs. per ampere. The torque per ampere varies between half load and full load in the ratio of 100 to 152, and not in the ratio of 100 to 110, as Carus-Wilson had stated. The value of this ratio increases as the rating of the motor is decreased. For example, under some conditions of rating, this motor might be styled a 50-hp motor. Under such conditions the value of the torque per ampere varies about as 100 to 165. The original motors built by the large electrical companies were very much underrated; this explains to some degree why we find now a decrease of this ratio. Carus-Wilson desires to increase the value of the torques at full load and at overload, *i. e.*, to make more of a load in the torque curve. This change will entail a diminution of speed for these loads; it will make the speed curve straighter. There are objections to this proposition. In order to insure sparkless commutation at full load and all overloads, it is necessary that the magnetic density must be brought to saturation in the pole face, the teeth, or the armature body; to make this effective it is necessary to cause a considerable bend in the speed curve. The type of motor made by the Steel Motor Co. has this carried to such an extent that practically the only point to be considered in connection with overload is the heating effect. Sparking at any overload seems unknown. This freedom from sparking is obtained at the expense of very heavy starting current. The same effect of sparkless commutation might be obtained by winding the armature so that it will not be so heavily loaded. This means that the iron sections must be increased, and that a motor of larger capacity must be bought. The dead weight carried by the cars must therefore be increased. A further advantage of early saturation of some part of the magnetic circuit is that we thus obtain a more constant speed and have more of the advantages of a shunt-wound motor—namely, constant speed at varying loads. This is especially advantageous on roads operated under steam railroad conditions, where a schedule speed must be adhered to under all conditions of traffic.—Lond. *Elec.*, April 25.

Armature Reaction of an Alternating-Current Generator.—ARNOLD.—A long communication, illustrated by diagrams. In the armature winding of an alternator, an e.m.f. is induced at no load, which depends only upon the exciting current. When the generator is loaded, the armature current produces an alternating magnetic field which reacts upon the armature winding, induces currents in the exciter circuit and eddy currents in the solid metal parts. All these actions may be called armature reaction, while the inducing action of the armature field upon the armature winding is simply self-induction. The voltage at the terminals of the generator decreases at load, if the excitation remains unchanged. In general, the e.m.f. induced by the field is no sine wave, and therefore a graphical addition of the vectors of the e.m.fs. is incorrect. Moreover, the effective resistance and the effective reactance of the armature winding are not constant; the latter depends largely upon the saturation of the magnet cores and teeth and varies during one period. If one wants to apply graphical methods, one must be satisfied with approximate results. The effective resistance depends upon the ohmic resistance, eddy currents in the pole shoes and variation of the reactance. He then distinguishes the different fluxes which determine the self-induction, and gives diagrams in which the different e.m.fs. are properly combined. He shows how, by different authors, either one or the other determining factor is overlooked. He gives a diagram from a book by himself and La Cour, as also the formulas for determining the various values in the diagram. He then discusses the following point: When the machine is loaded and the demagnetizing ampere windings weaken the field, there is a smaller saturation in the magnet cores and yoke; the magnetic reluctance is thereby diminished, and as the ampere windings of the exciting coils have remained constant, the field leakage is increased; but this increase is not great and is often exaggerated. He shows that in the worst case the leakage coefficient can become 6 or 7 per cent. greater than at no load; in most cases, however, the increase is insignificant.—*Elek. Zeit.*, March 20.

REFERENCES.

Voltage Drop in Alternators.—REZELMANN, CORSEPIUS, BAUCH, ROTHERT.—Further contributions to the discussion on the subject which has recently been going on in the correspondence column of this journal. Rezelmann replies to a criticism of Bauch. Corsepius agrees with Rothert that the dependency of the leakage flux upon the armature current is of importance; he gives some general notes on the leakage flux and on armature reaction.—*Elek. Zeit.*, March 13.—Bauch makes some remarks on diagrams for this matter, and discusses at length a suspiciously high leakage coefficient found by Rothert.—*Elek. Zeit.*, March 20.—Rothert claims the priority of the diagram for himself, and corrects a numerical error.—*Elek. Zeit.*, April 17.

Induction Motor.—ZIEHL.—A detailed illustrated description of construction and tests of a 10-hp, 190-volt, 50-periods, three-phase induction motor of the Schwartzkopff Co.—*Elek. Zeit.*, March 20.

POWER.

Small Water-Power Transmission Plant.—HARDESTY.—An illustrated description of a small water-power electric transmsision plant

for local lighting service in Utah County, Utah; this is considered as a good example of what could be done in utilizing the natural fall of many mountain streams in the West for the benefit of neighboring settlements. There is at present installed a 250-kw, 60-cycle, 6,600-volt, three-phase generator. The current is transmitted to a sub-station, five miles distant, where the voltage is reduced to 2,000. From there the current is transmitted to different places for lighting and power, 115 and 200 being the voltages used, respectively, for these purposes. The hydraulic installation is described in detail.—*Eng. News,* April 17.

REFERENCES.

Alternating-Current Transmission.—STURDEVANT.—A reprint in full of an illustrated paper read before the Cleveland Electric Club. He first gives a general graphical review of the phenomena taking place in alternating-current circuits, and then makes an application to a simple numerical case of power transmission. No use is made of higher mathematics.—*West. Elec.,* April 19, 26, May 8.

Boilers.—The whole issue, of more than 100 pages, consists of a profusely illustrated description of American stationary boilers and furnaces, and feed water heaters.—*The Eng.,* April 15.

Electrical Equipment of a Shipyard.—A long and well-illustrated description of the electric power distribution and application in the shipbuilding plant of the Fore River Ship & Engine Co., at Quincy, Mass. Direct current at 240 volts is used for all purposes.—*Elec. Rev.,* April 26.

Automatic Feed Water Purifier.—An illustrated description of an automatic water purifying apparatus for use in power stations where the water is not adapted to boiler feeding.—*St. R'y Jour.,* May 3, and Int. Ed., May.

TRACTION.

Train Resistance.—DAVIS.—The writer is one of the engineers of the General Electric Company, and conducted a series of tests to determine the train resistance at high speeds. These tests were made near Buffalo. He divides the resistance into three parts, viz.: First, friction of the axles and journals, which has been found to be independent of the speed; second, rail friction, which is assumed to be directly proportionate with the speed; and third, wind resistance, which varies with the square of the speed. He then submits a formula embodying these features. The tests referred to were made with a 37-ton electric freight locomotive, geared to a speed of 88 to 100 km per hour at average line voltage. The train was made up of a locomotive, baggage car and three standard passenger coaches, weighing on an average 26 tons each without load. The track was absolutely straight, with practically no grades, and was in good condition. The motors had previously been tested at the factory to determine the journal friction and gear friction. The inertia of the revolving elements, such as the armatures, gears and wheels, were calculated, and an allowance made therefor. At the time of the tests there was practically no wind. It was found that the addition of each car to the train increased the effective cross-section by approximately 10 per cent. Sample curves are given, which had been obtained with trains of different lengths. After these were run, a wooden shield was mounted on the front end of the locomotive, hinged at the lower end, and fitted with a system of levers and an adjustable spring balance to register the pressure. The writer then considers the effect of a rounded end on the car, similar to that of the vestibule on the ordinary high-speed electric car, and gives curves for a 25-ton, 35-ton and 45-ton car respectively. The constants in the formulæ are calculated, and are given in the three final formulæ in the paper.—*St. R'y Jour.,* May 3, and Int. Ed., May.

LUNDIE, DODD, BELL, WILLE.—Articles in which Davis' paper is critically discussed. Lundie criticises the method by which Davis determines some factors in his formula, and calls attention to the fact that he does not consider any other factors in the train except weight, area and speed; further, that details of Davis' tests should be given. He then mentions his own formula, in which resistance in pounds per ton varies as the first power of the speed, which gives correct results on all trains up to 48 km. per hour.—Dodd believes that a formula which would be correct, even to within 10 or 15 per cent., would be of great use, but thinks that the power could be calculated from the curves of the motors. He deplores the fact that the author did not give some data of the tests to which he refers, as confirming the correctness of the formula, and believes that the formula will not be correct at high speed, on account of the high value which has been assigned to one coefficient. He cites one or two tests which he had made which gave lower results than those from the Davis formula. He then compares Davis' results with those obtained by the Siemens & Halske Co. in their preliminary experiments on the equipment of the Berlin-Zossen road, by whirling a flat board or fan at the end of a long arm at various speeds. While the experimenters admit that their method was approximate only, the results are important, because if it is true that there is a difference of 400 per cent. depending upon the shape of the ends, it would affect the whole character of the Davis formula, and would require a somewhat higher value for two of his coefficients. With a 96-ton car with a front area of 9.36 square meters and a speed of 200 km. per hour, Davis' formula would give a power consumption of 2620 hp, whereas the Zossen experimenters estimated on only 950 hp.—Bell says that the equations of Davis call for about double the power found necessary in the most recent investigations, and so demand very critical examination. He shows in detail that Davis' formula does not agree with the results of others. He believes these conditions are due to errors in the method employed by Davis in making tests which were by the coasting method. This he looks upon with distrust, owing to the involved way in which the losses in the motor and gearing enter the results. He believes that a better method would consist in towing trains of various lengths and weights by means of a long wire cable and a dynomometer. This cable would have to be supported by light trucks at one or more intermediate points. This would also be a better method than that of determining the head air pressure employed by Mr. Davis, which was that of a front shield. This latter is open to the serious objection that the center of pressure is not easy to locate. If a head shield is used, it would be better to pivot it along one vertical edge rather than along the lower edge, or better to arrange it to slip bodily backward on anti-friction rollers.—Wille says it would be unfair to compare Davis' results with those obtained on steam roads, as the conditions are totally different. The chief difference is that the electrically driven trains are of lighter units than those propelled by steam. It is therefore reasonable to expect that he should obtain a higher value than that usually accepted by steam railroad engineers. When trains are operated at short headway, and it is necessary to accelerate them to high rates of speed in a short distance, the resistance due to acceleration is so large as to completely mask the frictional train resistance. When these facts are considered, the formulæ check the one derived by the Baldwin Locomotive Works very closely.—There is also a separate editorial discussion of the subject. Davis' formulæ are based on experimental runs made on the Buffalo & Lockport road; they are the first to be made on a modern electric road at high speed and under approximately service conditions. The results indicate about double the total train resistance found by other experimenters, and revert more nearly to early values obtained upon steam roads. These formulæ, however, are not accepted by the contributors who have reviewed Davis' article, and attention is called to the fact that the discrepancy between the results reported by Davis and those of other recent experimenters is so great as to require careful attention and revision. It is suggested that the entire subject be reconsidered, and that experiments be made which will not depend upon the same conditions as those upon which Davis' results were figured. Consideration of these papers leads to the inquiry whether a train, like a steamship, has certain critical speeds at which driving becomes relatively easy, and others at which increase of speed can only be obtained by a large additional power consumption. —*St. R'y Jour.,* May 3, and Int. Ed., May.

Electric Boats.—FLAMM.—An account of a series of experiments made first with two small electric model boats of 1.6 meters length and different form. The resistance and the behavior of the boats was studied at various speeds; the resistance was separated into wave-making and frictional resistance; the influence of speed and form upon the waves was studied. The result of these preliminary trials with the two models was the adoption of a model slightly differing from either for constructing a large boat, which is 16 meters long, 2.50 meters in width and 0.8 meter depth amidships, with a displacement of 17.20 cubic meters. The weight of the motor, accumulator, switches and conductors is 11,049 kilograms, or, for 60 hp, about 185 kilograms per motor horse-power; this is greatly in excess of that required for steam or internal combustion motors. At a speed of 10 knots the power required was 59.30 hp, at 7.70 knots 18.10 hp, and at 4.90 knots 5.30 hp. "At the speed of 10 knots

the radius of action was 30 sea miles, while at 4.90 knots this was extended to 220 sea miles."—*Schiffbau*; abstracted in *Eng. Mag.*, May.

Electrolysis Due to Stray Currents.—MOERK.—A communication in which he describes some experiments. It is known that the direction of the current changes in the pipes. To investigate what influence this may have upon the electrolysis, he placed four equal lead pipes into two cases, two into each. Each was filled with the same wet material. The one pair was always supplied with current of the same direction, while for the other pair the direction was changed from day to day. After three weeks the pipes were examined. One pipe, which had always been positive, had lost 155 grams. In the other case the loss of the two pipes together was only 90 grams. The danger of electrolysis due to stray currents from tramway rails can therefore be diminished by changing the direction of the current in the traction system at regular intervals.—*Elek. Zeit.*, March 27.

Car Wiring.—An illustrated note on a departure in car wiring. In a car having twenty lamps, the lamps are arranged in groups of four in multiple, instead of having five lamps in series. The advantage of this arrangement is that in case a lamp burns out, only one light goes out instead of five. This is particularly desirable when the headlight is on the circuit.—*St. R'y Jour*, May 3, and *Int. Ed.*, May.

REFERENCES.

Block Signals.—KOHLFUERST.—After giving an illustrated description of the system of block signals used at the terminals of single track portions of the Buffalo-Lake Erie road, which in other parts has double track, he suggests modification of the system.—*Elek. Zeit.*, March 20.

Thirty-two Thousand Volt Transmission Line in Indiana.—An article on the system of the new traction company of Indiana, which is operating about 250 km. of track, power being transmitted at 14,000 volts. The company is planning an extension of about 150 km., and for this will transmit power at 32,000 volts. There will be three substations, one of which will be 96 km. from the power station.—*St. R'y Jour., Int. Ed.*, May.

Street Railway Accounting.—The beginning of a new department, conducted by Calderwood. There is an article, by Calderwood, on the modern accountant; a second article with the title: "From the Conductor to the Bank," and an article, by Mackay, on the creation of reserve funds.—*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Mains Department of a Direct-Current Station.—MOORE.—An abstract of a paper read before the Newcastle section of the (Brit.) Inst. Elec. Eng. The type of mains to be adopted was first discussed, the points raised being the liability to short-circuit or earth, repairs, alternation to any section, first cost, and life. The various systems were criticized, no one apparently filling all his requirements. Short circuits in distributors of large sections may be burned out by reason of the energy available, but the feeders present a vulnerable point in the system. The taking of positive, middle and negative feeders to one point was debated, it being possible to obtain better pressure distribution by separating the poles by a distance of some hundred yards. Meters are preferably tested from some steady source of energy, such as a special battery, rather than from the supply mains. He considers that the maximum demand and discount systems should not be used on the same system of supply, and that meter rents would become more acceptable to the consumer if a nominal charge were made. The cost of mains and their laying was illustrated by diagrams.—Lond. *Elec.*, May 2.

REFERENCE.

Power Plant of Factory.—RICE.—An illustrated description of the power plant of the Otis Elevator Company, at Yonkers, N. Y. For lighting and power purposes the 220-volt, three-phase, three-wire system is used. For testing, electromotive forces of 110, 220, 330, 440 and 550 volts can be obtained by series connection of various circuits.—*The Eng.*, May 1.

WIRES, WIRING AND CONDUITS.

Cost of Cables.—COHN.—An article referring to the formula often given for the cost of a line as the product of the length in meters and a factor $A + B Q$, where Q is the cross-section in square millimeters, and A and B are numerical values. He has calculated the latter values for different types of cables from the price lists of the manufacturers. The results are given in a table. It is restricted to cables to be buried in earth. When he plotted the curves for the cost as a function of the cross-section, he found that the above formula is valid only for cross-sections greater than 25 square millimeters; for smaller cross-sections B increases and A decreases. For voltages higher than 3,000, the above equation is valid only for cross-sections between 50 and 70 square millimeters.—*Elek Zeit.*, March 27.

ELECTRO-PHYSICS AND MAGNETISM

Oscillation of Ions.—DAVIS.—An article in which he describes how Cremieu's failure to produce motion in a charged plate by means of an oscillating magnetic field, has led him to the idea of substituting for the charged plate a body capable of carrying an enormously greater charge in proportion to its mass, viz., the ion itself. He produces a "ring-discharge" in a tube surrounded by a coil conveying a Tesla discharge. In this arrangement no electrodes are used. The ions are set into an oscillatory motion along circular arcs concentric with the coil, the negative electrons exerting a greater effect in the way of collisions and ionisation than the positive ions, on account of their superior speed. He mounts a set of four vanes on a needle parallel to the axis of the coil. The vanes are convex on one side and concave on the other. It is practically a miniature anemometer, which rotates in the direction of the convex side of the vanes, whatever the direction of the impinging electrons may be.—*Phys. Zeit.*, April 1; abstracted in Lond. *Elec.*, April 18.

Oscillatory Charging Currents.—ANDRIESSEN.—A description of some interesting experiments. A condenser may be discharged by an oscillatory spark, and similarly it may be charged by introducing a spark-gap which produces oscillation. He has made the following experiment. The secondary of a transformer is connected to a circuit containing a condenser, an incandescent lamp and a spark-gap. He first short-circuited the spark-gap and brought the transformer up to 6,000 effective volts at 50 periods, then the charging current was not strong enough to make the lamp glow. The spark-gap was then opened to 0.5 mm; then the lamp glows, even with only 2,100 volts. He explains this result by the increased quantity of electricity which passes the lamp, owing to the charging current of the condenser being of an oscillatory character. This may be of practical importance for a wattless introduction of capacity whenever the object is to get rid of noxious inductive phase displacement. It also accounts for the superiority of oil insulation, as against air insulation, since the latter leads to the appearance of oscillating sparks which are damped out in the former.—*Ann. der Physik*, No. 4; abstracted in Lond. *Elec.*, April 25.

Large Electromagnets.—THORNTON.—The first parts of a very long illustrated mathematical paper, read before the Newcastle section of the (British) Institute of Electrical Engineering, on the distribution of magnetic flux in large electromagnets. He describes a method of measuring the flux at any point of the magnet circuit and its variation with the magnetizing currents or the time. The essential part of the method consists in observing a prolonged induced voltage in a secondary exploring coil when the current in a primary is made or short-circuited. He gives details of the tests on a 50-kw dynamo with 16-in. diameter magnet cores. The maximum leakage coefficient is found and shown to vary with the load, decreasing as the load increases. Tables are given of the relative and absolute flux through several sections of the magnetic circuit. The effect of hunting in the engine and of irregular turning moment is observed by variations of the magnetization of the machine. The curves are analyzed and compared with the theory. The initial rate of change of permeability at "make" and "short-circuit" is found, and its effect on the shape of the curves discussed. The initial throw is shown to be independent of the material of the core. A powerful recording ammeter is described. Tests were also made with three generators, and the leakages at several parts of their circuits at no load examined. A new method is given of determining the permeability of large iron cores. An investigation of the change of permeability with time shows slipping of the molecules at saturation, as indicated by Ewing's theory of magnetism, but not hitherto observed. Heaviside's formulæ for the decay of induction in cores are applied to a machine, and a satisfactory agreement is found.—Lond. *Elec. Eng.*, April 11, 18.

Cathode Rays in a Magnetic Field.—PELLAT.—An investigation of the problem of the solid tubes of magnetic force traced out by cathode and canal rays under certain conditions. In strong fields the cathode

rays follow the tubes of force. He believes that there is some agent at work which makes the corpuscles run along the lines of force, and that this agent is of the nature of a friction across the lines of force. —*Comptes Rendus,* March 24; abstracted in Lond. *Elec.,* April 18.

Lightning.—An illustrated discussion of the question whether lightning is oscillatory. An account is given of experiments made by Walter, who photographed lightning flashes by means of a rotating camera. A lightning flash then appears to consist of a series of several successive discharges, the time intervals between them being very unequal. The discharge of a lightning flash appears to be not oscillatory, but intermittent and undirectional. In almost all cases when a discharge takes place between a cloud and the earth, the cloud is positive to the earth.—Lond. *Elec. Rev.,* April 18.

Waves Emitted by Thunderstorms.—LARROQUE.—An account of a continuation of his studies of Hertzian waves emitted by lightning flashes over enormous distances. The waves arriving from a great distance are practically horizontal. When, on the other hand, the storm is in sight, or at all events not further off than 200 miles, the waves are more vertical than horizontal.—*Comptes Rendus,* March 10; abstracted in Lond. *Elec.,* April 18.

Cathode Drop and Current Strength.—STARK.—The normal cathode drop of potential in the case of the glow current is independent of the pressure of the gas and of the current strength. The law of the abnormal cathode drop is less determined; both Schmidt and Skinner declare it to vary in a linear and positive manner with the current strength. The present author maintains, on the other hand, that the true relation is indicated by a curved line.—*Phys. Zeit.,* April 1; abstracted in Lond. *Elec.,* April 25.

REFERENCE.

Model for Demonstrating Alternating Currents.—HEILBRUN.—An illustrated description of a mechanical model for demonstrating the fundamental terms of the theory of alternating currents, such as direction of current and e. m. f., maximum values, mean value, period, phase and phase difference, etc.—*Elek. Zeit.,* March 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Barium.—STANSFIELD.—A paper read before the Manchester Lit. & Phil. Soc., giving "a preliminary note on the preparation of barium." After a discussion of the method of distillation of amalgam and the method for preparing zinc alloys, he describes experiments with the Goldschmidt process, whereby oxides are reduced by means of finely divided aluminum mixed with them in an intimate manner, and in which the heat of the reaction, being very large, is generally sufficient to fuse even the alumina formed. The experiments were carried out under reduced pressure, crucibles of Veitsch magnesite being used. In the earlier experiments the charge consisted of barium peroxide and aluminum. It was afterwards found to be more satisfactory to use nothing but the peroxide and aluminum. The experiments seem to indicate that the reaction is reversible, and that it cannot be used to obtain pure barium, but only an alloy of barium with aluminum containing up to about 60 per cent. barium. —*The Elec-Chem. & Met.,* March.

Copper Refining.—The introduction of magnesium into molten copper, with a view of getting rid of the various impurities (like oxygen, sulphur, carbon, etc.) is difficult and even dangerous. According to Froment, the Aluminum and Magnesium Plant Hemetiagen has recently patented the manufacture of an alloy of Mg. and Cn., 50 grams of which are said to be sufficient for the refining of 100 kilos. of copper. The alloy contains equal parts of Mg. and Cn.; it melts at 450° C. This material is of a greyish-red color and fairly brittle; specific gravity = 2.97.—*L'Electrochemie,* v. 7, 2; abstracted in *The Elec.-Chem. & Met.,* March.

Mond's Process for the Electrodeposition of Zinc.—An illustrated description of this process, which is said to give coherent metallic deposits of zinc of any desired thickness by subjecting the metal to a constant rubbing action under pressure while it is being deposited, by precipitating the zinc from its solutions in acids or alkalies upon revolving cylinders, and arranging several of these cylinders so as to touch one another in an electrolytic bath. These cylinders are provided with shafts moving in bearings, which are mounted so that they can slide, and pressure is applied to all or several of these cylinders by means of weights, springs, levers, or other mechanical devices which press the cylinders against each other, and at the same time allow them to move further apart as the thickness of the zinc deposited upon them increases. The cylinders may be made alternately of slightly different diameters, so that the same points on their circumferences do not come in contact until after many revolutions. In order to facilitate the removal of the deposited zinc, the cylinders are covered with a little graphite or paraffin, or any other substance which prevents the deposited zinc from adhering to the metal of the cylinder.—*The Elec.-Chem. and Met.,* March.

REFERENCES.

Aluminum.—LANGLEY.—An abstract of a recent lecture held at Sibley College. The problem which had to be solved as basis of the present industry was to find a solvent which dissolves large quantities of aluminum oxide and at the same time requires a higher e. m. f. of decomposition than aluminum oxide; this solvent is cryolite. The general arrangement of the electrolytic process is described.—*Sibley Jour.,* April.

Max Accumulator.—An illustrated description of this French lead storage battery, which has been noticed before in the Digest. *Sc. Am. Sup.,* April 19.

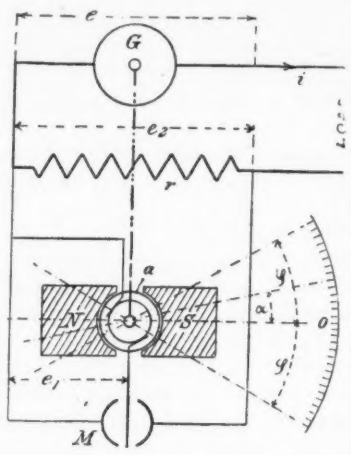
Electric Furnaces.—BLOUNT.—The first part of an illustrated reprint in full of his paper, recently abstracted in the Digest.—*Sc. Am. Sup.,* May 3.

Alkalinity of Blood.—HENRI.—An article on the theory of electrolytic dissociation and its application to the measurement of the alkalinity of blood.—*Rev. Gen. des Sc.,* April 15.

Diffusion of Electrolytes.—THOVERT.—A description of some experiments on diffusion phenomena of electrolytes, and their explanation by the electrolytic dissociation theory.—*Comptes Rendus,* April 14; abstracted in Lond. *Elec.,* May 2.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Application of the Electrometer to Alternating Currents.—HOHAGE.—An article describing a method of applying the electrometer to alternating currents, for measuring power, current, and phase difference. The connections are shown in the adjoining diagram: *G* is an alternator, *r* a known resistance, which does not need to be non-inductive, *M* is the electrometer. Between its needle and one pair of quadrants an auxilary e. m. f., equal to e^1 is connected, while the other pair of quadrants is connected to the terminal of the resistance *r*. If the voltage e^2 at the terminals of the resistance *r* is small compared with e^1, then the reading of the electrometers is proportional to $e^1\ e^2\ cos\ (e^1\ e^2)$. To produce e^1, the auxiliary e. m. f. there is mounted on the axle of the generator an alternating-current armature *a*, provided with many thin windings. The field magnets *N S* can be moved around the axle of the armature. If they are in the position *O*, then e_1, which is induced in the armature, may reach its maximum value at the same moment when the *e* of the generator is a maximum. If, however, we turn the magnets through an angle, then e_1 in the auxiliary armature lags behind *e* by the same angle. The reading of the electrometer reaches a maximum, when e_1 is in phase with e_2. When e_2 is in phase with *e*, *i.e.*, when the load and the resistance *r* are non-inductive, the maximum reading is obtained in the position *O*. If, however, the phase difference *c* exists between e_2 and *e*, the reading in the position *O* gives $e_2\ cos\ c$, and in order to get e_2, we must use an auxiliary e. m. f. like e_1, displaced by *c* against *e*. This phase displacement can be obtained by turning the field magnets through the angle *c*. When then the angle of phase (*i.e.*) has the known value *a*, then the instantaneous phase difference is $c + a$, and can be read directly after *N S* has been turned, until the reading of the electrometer is a maximum. At the same time the maximum reading gives a measure of the total current. When *N S* is placed into the position given by the angle *a*, the electrometer gives the watt current, while for the angle $a + 90$ degrees it gives the wattless current.—*Elek. Zeit.,* April 24.



DIAGRAMS OF CONNECTIONS.

Damping of Electric Oscillations.—ZENNECK.—A description of a method of studying the damping of rapid electric oscillations by

means of a Braun cathode-ray tube. The trace of such oscillations on the luminescent screen consists of a line of beads or bright patches extending on both sides of a bright center, and becoming fainter and wider apart the further they are away from the zero or middle position. These beads, he points out, are the turning points of successive oscillations. They become visible owing to the reduced velocity, and, consequently, to the greater illuminating power of the oscillating cathode rays at those points. Hence the distances between the beads and the zero position mark the successive amplitudes of the oscillations. When a large number of discharges take place in short succession under the same conditions, the beads appear stationary, and may be photographed. At all events they furnish a delicate test for the regularity of the discharge, and show the influence of inductance, resistance and spark potential. He reproduces photographs obtained with a frequency of over a million per second, and some 600 discharges per second, the deflection being either magnetic or electric.—*Ann. d. Phys.,* No. 4; abstracted in Lond. *Elec.,* April 25.

Mechanical Break for Induction Coils.—TURNER.—A (Brit.) Phys. Soc. paper, describing a mechanical break for induction coils. It consists of two metallic rollers with their axes parallel and kept in contact by a spring. One of the rollers has a cam attached to its spindle, and can be made to rotate by means of a small electric motor. Once in each revolution the cam separates the rollers, thus making the break, and at the same time causing the second roller, which rides loose upon its axis, to turn about one-eighth of a revolution. As soon as the cam has passed, the rollers are brought into contact by the spring, and the next break occurs at a different place. The break is placed in a box containing alcohol or petroleum. The noise which the break makes when working is an objection. Noble exhibited a similar break.—Lond. *Elec.,* May 2.

REFERENCE.

Testing Voltmeters.—LAWS AND COOLIDGE.—An illustrated description of an apparatus used at the Mass. Inst. of Tech., for the rapid comparison of voltmeters with a standard instrument.—*Tech. Quart.,* March.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Submarine Telephone Cables with Increased Self-Induction.—KRARUP.—An article in which he refers to experiments made by Breisig with a telephone cable in which an open spiral of band iron was wound around the copper core; an increase of the self-induction by 57 per cent. had thereby been obtained over that of the cable without iron, and Breisig believed he had thus obtained the maximum possible limit of self-induction. The present author refers to older experiments of Hughes, who had found that an iron cover gave a much greater self-induction when the transverse cross-section of the iron was a complete closed ring (from similar results Hughes had drawn conclusions which were directly opposite than those drawn at present, because he thought that self-induction was undesirable in telegraph cables). He, therefore, suggests using a closed ferromagnetic cover; this is best obtained by a tightly-wound layer of soft iron wire. He made measurements of the self-induction of single and double conductor lines and cables of such construction. The results are given in a table; the following are quite interesting: While in a cable without iron or with a common iron cover, the self-induction is greater for single conductors than for double conductors, the reverse holds good for cables with iron cover around each core. The increase of the self-induction due to the iron is then twice as much for double conductors than for single conductors. The self-induction due to the iron cover increases in a greater proportion than the iron weight, when the magnetic circuit is more nearly closed. The fine, tightly-wound wire with great permeability is far superior to the band iron. He advocates the use of a thin layer of varnish between the copper conductor and the iron wire. He thinks there would be no great risk in constructing a submarine cable of this construction. (He does not seem to have included a cable in which the iron is applied in the form of two spirals of flat bands, wound in opposite directions, thereby reducing the magnetic air-gap very greatly compared with what it would be with cylindrical iron wires, even though they are of small diameter).—*Elek. Zeit.,* April 17.

REFERENCE.

Scientific Basis of Spark Telegraphy.—SLABY.—An illustrated English translation in abstract, of his German paper on the theoretical foundations of wireless telegraphy recently noticed in the Digest.—Lond. *Elec.,* April 25, May 2.

MISCELLANEOUS.

REFERENCES.

British Institution.—The London journals announce that the president elect of the (Brit.) Inst. Elec. Eng. for the next year is James Swinburne. His biography, with portrait, is given in Lond. *Elec. Times,* May 1.

Model of Contracts.—A reprint of the "form of model general conditions" proposed by a committee of the (Brit.) Inst. Elec. Eng., for use in connection with electrical engineering contracts; with editorial notes.—Lond. *Elec.,* April 25.

New Books.

RECHERCHES EXPERIMENTALES SUR LES SPECTRES D'ETINCELLES. By G. A. Hemsalech. Paris: A. Hermann. 138 pages, illustrated. Price, 6 francs.

This little volume contains the results of a research upon the modifications introduced into the spectra of condenser spark-discharges between metallic electrodes, by the insertion of inductance into the discharging circuit.

The work is divided into two parts. The first part occupies but twenty pages, and refers to the extinguishing effect of induced magnetism and eddy currents in self-induction coils upon the oscillations accompanying an electric condenser discharge. Photographs taken of such discharges on a film bound to the surface of a rapidly rotating pulley show that whereas in a simple discharging circuit without any iron core in the coil included, about 20 visible pictures of successive diminishing sparks could be obtained at a single discharge; yet on introducing a small iron core into the coil, the number of visible pictures reduced to 5. This result, while interesting as recorded, was, of course, to be expected.

The second and more important part is devoted to the result of a photographic study of the spectrum of the discharging spark, under the presence and absence of a coreless inductance coil in the circuit. The results are very interesting. They appear mainly to depend upon the change in the temperature of the spark under the variation of electric conditions due to inductance. The spectra of fourteen metals are studied successively. It seems that inductance diminishes the spectra of zinc, cadmium, magnesium, tin, lead, bismuth, copper and silver, by tending to reduce the temperature of their spark discharge; while the spectra of iron, nickel, cobalt and manganese are reinforced by the presence of inductance, owing perhaps to an elevation in the spark temperature,

The research has evidently absorbed a large amount of experimental work, and must have demanded considerable experimental skill. It goes to show the complexity of the phenomena comprised in an electric spark discharge, and the importance of specifying the precise electric conditions under which such discharges may occur, in order that the results may be comparable. The research concludes, very fittingly, with a résumé and series of conclusions. The volume is unique in being dedicated to two different scientists (Lippmann and Schuster).

WOERTERBUCH DER ELEKTROTECHNIK. Deutsch-Franzoesisch-Englisch. Paul Blaschke. 1 Theil. Leipzig. S. Hirzel. 1901. Cloth. 146 pages.

This is the first volume of a series of three polyglot vocabularies intended for electrical engineers. It contains the German terms with their French and English equivalents, while the other two will contain the French and the English respectively with their corresponding equivalents.

While it is not possible for a reviewer to say that it is very complete, a comparison with another well-known and earlier polyglot vocabulary published in Paris, shows that it contains many more electrical terms, chiefly the composite words; moreover, it gives the gender of the words, which is not done in the other dictionary referred to. It therefore is more complete than the best other dictionary of its kind known to the reviewer. Comparing it in number of words with an English dictionary of electrical terms, however,

shows that either many terms are missing, or else, and more probably, that the German language contains fewer electrical terms than the English.

The English terms are not always the best, nor are they always correct, which shows that they have not been revised by a good English authority. But for English speaking readers, the fault is not serious; it is to be hoped, however, that when the English volume is prepared it will be thoroughly revised by a native American or Englishman who is also familiar with the German and French terms.

Besides the electrical terms it includes many that are not in any sense electrical. The idea probably was that electrical engineers use them also, but this excuse for including them also applies to thousands of other technical terms, and it seems therefore somewhat inconsistent to enter the non-electrical field at all without making it a complete technical vocabulary including all branches of technology. However, an excess of words is not an objection as a deficiency would be, and as the book is low priced, one does not feel that one is paying for what one does not want.

While the author's preference for the use of the almost international term hydrogen in German in place of the older and senseless term *Wasserstoff* (as oxygen is just as important a constituent of water as hydrogen is), is, in the reviewer's opinion, a very sensible conclusion and one which should be encouraged, yet he goes too far when he omits the word *Wasserstoff* entirely, as it is often found in German literature. We notice also that the word Gauss is omitted entirely.

Typographically the book is very creditably arranged. The leading word is printed in bold, plain and clear type, which greatly facilitates finding it quickly. Placing the appendix of about a hundred overlooked words at the beginning instead of at the end, as usual, is to be commended as it is then less likely to be overlooked.

As a third of a polyglot vocabulary of electrical terms, the book can be highly recommended and is probably the best of its kind. With a few unimportant exceptions, the work seems to have been very well done. Typographically it leaves little or nothing to be desired.

A MANUAL OF PHYSICAL MEASUREMENTS. By John O. Reed, Ph. D., and Karl E. Guthe, Ph. D. Ann Arbor, Mich.: George Wahr. 185 pages, 86 illustrations. Price, $1.50.

This is a laboratory manual pure and simple for the use of college students in their earlier laboratory work, and a very excellent specimen of its kind. In the preface the authors state: "A manual equally suited to all laboratories has not been, and probably will not be written. Each laboratory reflects in greater or less degree the individual trend of the man who stands at its head. . . . Hence it happens that one laboratory is largely devoted to the study of the phenomena of light, another to those of electricity, a third to those of elasticity. . . . The moral of all this is that the practices and traditions of each laboratory are best conserved by a text representative of its own methods, and if no better reason should be found perhaps this may serve to explain the appearance of this, another laboratory manual." From the above it will be seen that the limitations of such a treatise have been fully realized.

The introductory chapter, containing remarks on measurements in general, is most terse and pointed, and if the student will digest it fully and has its importance firmly impressed on his mind, he will have an excellent foundation to start from. That "the ability to use delicate apparatus without injuring or destroying it is an important part of a liberal education" is too little appreciated.

The University of Michigan, for the students of which college the volume is written, very evidently comes under the head of those having laboratories largely devoted to the study of electricity, sixty-seven pages being devoted to measurement in this branch of physics, as against six for sound, fifteen for heat, and twenty-two for optics; physical measurements, however, very naturally coming in for a good share of attention.

A review of the electrical section would probably not interest the profession at large, particularly as its contents are hardly novel from an engineering standpoint. Anyone engaged in teaching marksmanship to the young idea can, however, read it to advantage, and many will doubtless find it a desirable volume to place in the students' hands.

If the reader will use his head at all, the abrupt little "Why?" that throughout the work frequently follows a cautionary remark or a direction, will cause him to do some thinking that will be very good training.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Extra meeting, 220 West Fifty-seventh Street, New York, May 28; annual convention, Great Barrington, Mass., June 18-21, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

A New Series Enclosed Arc Lamp.

A recent type of long-burning series differential enclosed arc lamp is being introduced by the Fort Wayne Electric Works, for which a number of special features are claimed. The general appearance of the lamp is shown in Fig. 1. The cap or top of the case from which the lamp is suspended and which supports the mechanism of the lamp, is of cast iron, which prevents any distortion of the parts in case the lamp should be roughly handled. The cylindrical part of the case is made of heavy copper sheeting with one soldered lapped joint. It is held in place by a bayonet catch, and is weather proof and designed to withstand the roughest usage. The mechanism is of the differential type and is extremely simple in construction. When the lamp is in operation the armature is practically in a horizontal position, directly beneath the series and shunt magnets. This makes a magnetic floating suspension for the armature, and reduces friction to a minimum.

The series shunt coils are wound on independent cores and held in place by one large screw, which can be easily removed with an ordinary screw-driver. These coils are so proportioned that they have considerable radiating surface per watt of energy expended in them and operate at low temperature. All connections that carry current are made with copper clips and fastened by two screws. These screws enter into cast-brass lugs, which are mounted in a position where they are readily accessible. The loosening of one of these screws breaks five connections, and the loosening of the other breaks three connections.

The adjustment coil, by means of which the voltage at the arc is regulated on circuits of different voltage, is wound on a form consisting of a brass tube covered with asbestos and mounted on a cylindrical wood core. This rigid construction prevents the wire from becoming loose and allows the coil to be readily removed from the lamp by loosening the clip screw at the top and bottom of the core. The cut-out is unique in design, and is so constructed as not to get out of order. It is composed of three stationary parts and one moving part. A brass cylinder traveling in a vertical direction makes and breaks contact with the stationary terminals in such a manner as to bring the arc always on the same contact. The various parts of the cut-out can be readily removed in a few seconds.

In the outer globe holder, provision has been made for the expansion of the globe when heated by the arc. The globe is clamped in place in the holder by thumb-screw clips, with specially designed springs that fit the curvature of the globe and will not permit the clamping screw to exert sufficient pressure to crack the globe. The globe holder is held in position directly beneath the radiator by a bayonet catch similar to that holding the cylindrical case, and has attached to it a chain from which it is suspended while the lamp is being trimmed. The assembled globe holder may be removed entirely by simply lifting the chain and hook from a lug cast on the side of the radiator.

The lamp is equipped with a corrugated cast-iron radiator, which

rapidly dissipates the heat arising from the arc and prevents its entrance to the mechanism chamber, thus insuring an extremely low operating temperature in the lamp. The radiator is designed to permanently protect all parts of the lamp located beneath it from moisture, snow and dirt, and all parts located above it from the heat of the arc.

The clutch is what is known as the three-jaw ring clutch, and is extremely simple in construction. On the top and in the center of the main clutch casting is mounted a small copper ring with three inwardly projecting jaws. Only these three jaws come in contact with the carbons. This arrangement allows the use of carbons differing slightly from the standard size specified to be used with the lamp. The small ring containing the three jaws can be replaced by the removal of one screw. The clutch is so designed that it is impossible to insert any part in any but the right position.

The upper carbon holder is combined with the trolley which carries current to the upper carbon, and consists of a phosphor-bronze vertical split holder, insuring even distribution of pressure on the part of the carbon covered by its jaws. The lower end of the solid piece of brass on which these jaws are mounted projects downward between the jaws, and serves as a stop for the upper carbon and prevents its entrance into the holder beyond the correct position. No steel springs are used in the construction of the holder, and should it become damaged it can be easily replaced by the removal of two screws. The trolley of the lamp is made from a solid piece of brass with circular grooves milled therein at angles 120 degrees apart. These grooves contain semi-circular contact springs which protrude above the grooves and make edge-wise contact with the carbon tube. The planes of these edges are at right angles to lines passing through the center of the body of the trolley. This form of construction prevents corrosion and accumulation of dust and dirt between the surfaces of the trolley springs and the carbon tube.

FIG. 1 AND 2.—SERIES ENCLOSED ARC LAMP.

In trimming the lamp the carbon is automatically centered, and the surface of the contacts between the trolley spring and the carbon tube is automatically cleaned. In the top of the carbon tube is a nut, on the lower surface of which is a projection which enters the center opening in the top of the body of the trolley or carbon holder, thus always centering the carbon without any special effort on the part of the attendant.

The adjustment of the length of the arc is accomplished by the adjusting coil in shunt with the series magnet coil. On loosening one screw the adjusting clamp may be lowered or raised, increasing or decreasing the amount of current passing through the series coil, thus causing it to operate at a longer or shorter arc as may be desired.

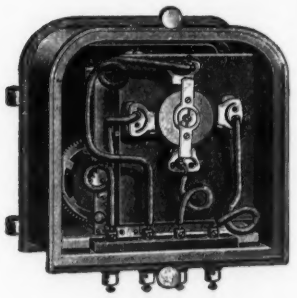
The gas cap is made of two parts, thoroughly insulated from each other, so that there is no difference of potential on its top. This is an important point, as a gas cap constructed so that there is a difference of potential on the top sooner or later causes trouble on account of short-circuit created by the collection of dust and dirt. The opening in the gas cap through which the upper carbon passes is provided with a copper bushing, easily removed should it become damaged.

The binding posts are of ample proportion and are provided with porcelain petticoat insulators and a rubber insulating washer, which makes the joints water-tight. They are further provided with set screws for clamping the wires in a vertical position, so as to make a strong mechanical as well as a good electrical connection.

One of the features of this lamp is the ease with which it can be dismantled should repairs become necessary. By the removal of five screws, two brass spring cotters and a clamping nut on the bottom of the clamping tube, the entire bottom part of the lamp below the radiator can be removed from the carbon tube, leaving only in connection therewith the armature, the shunt and series coils with their castings, and the cast-iron top. The magnets, armature and casting upon which they are mounted can be easily removed from the carbon tube by removing the cast iron cap, two spring cotters and four screws. The cast-iron top can be removed by simply taking off the binding posts. The trolley and carbon combined can be released by removing the cast-iron top and taking off one nut. By the removal of the outer globe and the cylindrical case all sides of the mechanism are exposed. In fact, the lamp has been so designed that any part of it is rendered accessible by a few moments' work. All the nuts in the lamp are made the same size, a fact that will be appreciated by the repair man.

Acme Time Switch.

In the accompanying illustration is shown a partial view of the mechanism of the Acme time switch, manufactured by the Acme Switch Company, 438 Asylum Street, Hartford, Conn., and designed for the automatic control of electric lighting circuits. This switch, which is of the snap type, can be used on any direct or alternating-current circuit up to 250 volts, and gives a quick break. It is made in two sizes, viz.: 15 amperes double-pole and 25 amperes double-pole, each being provided with an eight-day clock movement.



TIME SWITCH.

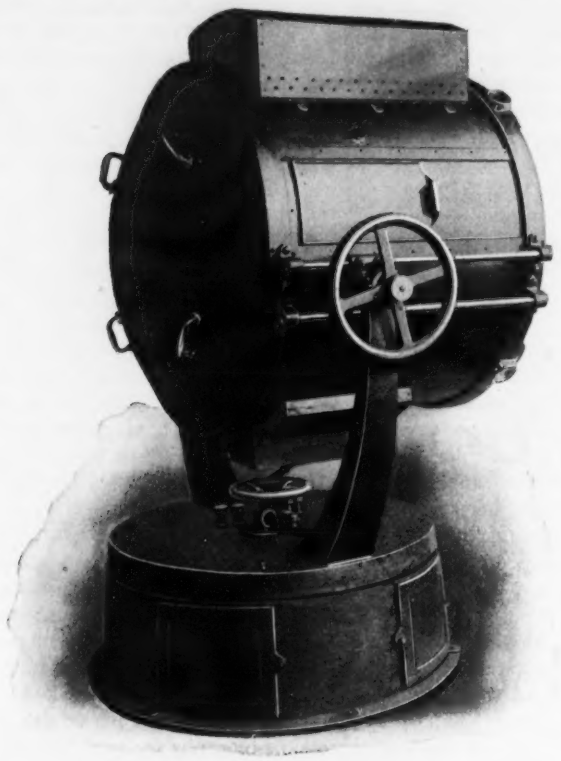
Another style of switch is of the single-pole rotary type, especially designed for outdoor work where a central station wishes to control one or two arc lights. The clock movement of this switch is stated to be able to withstand the variations of heat and cold. It is made in two styles of the same size as the snap switch above described. The instruments are compact in design and are encased in a substantial metallic waterproof box. The binding posts are located outside of the box, thus permitting the placing of the instrument in position without having to expose the mechanism. One of the chief merits of this switch, it is stated, is its prompt action at the proper time.

Naval Projector.

The cut on next page shows a projector of the naval type recently built by Chas. J. Bogue, 213 Centre Street, New York, the apparatus being constructed entirely of iron. The cylinder has an outside diameter of 34 inches and is provided with longitudinal rods passing through the trunnions, which allow the cylinder to be shifted on the

bearings to insure a perfect balance at all times, the hand wheel being used to lock the cylinder in any desired position. The supporting arms are bolted to the turntable, which moves on a series of steel balls; the balance is so exact that a slight touch is sufficient to move the heavy upper parts in any direction required. A half turn of the wheel on top of the platform locks the searchlight as required.

The cable leads through the base and is connected with a commutator set on the top of the base, and a corresponding commutator on the underside of the turntable, from which latter the wires run to the lamp. This forms a perfect contact for the heavy current used. The mirror is of the Mangin type, and is 30 inches in diameter, with a focal length of about 17 inches.



NAVAL PROJECTOR.

The lamp is automatic with a hand-feed attachment, and is trimmed with carbons 1¼-in. diameter positive and 1-in. diameter negative. The rheostat with regulating switch is adjusted to pass 100 amperes when the voltage of the circuit on which the light operates is 230 volts. The net weight of the apparatus complete, with the rheostat, is 1,050 lbs., and the shipping weight, 2,100 lbs. This projector was recently shipped to South America.

Holly Gravity Return System.

Mr. C. S. Wilson, chief engineer of the 4½ Street power station of the United States Electric Lighting Company at Washington, D. C., has made a very favorable report upon the performance of the "Steam Loop and Holly Gravity Return System" in the plant under his charge. The plant contains six boilers, aggregating 1,600 horse-power, four tandem-compound condensing engines and two single-cylinder non-condensing engines. The four tandem engines are directly connected to railway generators and two single engines to lighting generators. The six engines have a maximum capacity of 3,000 horse-power.

The engines were all equipped with separators, and the separators with traps, and the traps all discharged in the sewer. Now all of the condensation from the high-pressure drips goes to the boilers. Referring to his experinece with the system, Mr. Wilson says that he is safe in asserting that it has made a saving of .2 of a pound of coal per kilowatt-hour, which would mean a saving of from 1 to 1½ tons of coal per day.

Among the advantages of the Holly system is, first of all, that it effects a considerable saving in the water of condensation, of entrainment and primage, with the heat contained. The return is usually made at from 250 to 400 degrees, according to the pressure carried, while the best of feed-water heaters furnish water at not more than 200 to 210 degrees. Another advantage is in preventing the loss of steam that is blown to waste in clearing pipes from water, and the numerous wastes from open or leaky drips. Moreover, by returning pure water to boilers, and by concentrating this return in one or two boilers at a time, loosening the scale, the system frequently furnishes the entire feed water for one boiler in a battery of twelve. Accidents due to water in cylinders are prevented, and uniform temperature is preserved in pipes over nights and Sundays, thus obviating difficulties due to expansion and contraction. This arrangement, in addition, enables engines, especially at the end of long lines, to start promptly and safely, and it reduces the amount of cylinder oil removed by the washing action of the water. It is effective also in maintaining higher temperature in jackets, driers, etc., by reason of better circulation, and in reducing the amount of attention necessary to the steam pipe and its drainage, as it affords a comprehensive drainage system, operating continuously, and supplanting all devices requiring attention, manipulation or repair.

This system has been installed in a large number of central station and industrial plants by Westinghouse, Church, Kerr & Co.

Back-Geared Motors.

The accompanying cut shows a 1-hp back-geared motor, one of a line being manufactured by The Holtzer-Cabot Electric Company, of Boston, Mass. These motors are made in the usual sizes from one-sixth up to 20 hp. They are bipolar up to 3 hp, and above that multipolar.

The poles are laminations of soft steel, which fit into curved seats in the field ring. The motor is made both in the semi-enclosed and completely enclosed form.

The heavy casting which holds the gear shaft is bolted to the body of the motor and is entirely separate from the end cases, so that either the gear rigging or armature may be removed without interfering with each other. The alignment of the gear shaft is quite independent of the end cases, so that the motor may be run in any position by simply turning the end cases through a portion of a

BACK-GEARED MOTOR.

revolution, in order to keep the oil rings in proper position. Self-oiling and self-aligning bearings are used.

The brush ring is held in a machine seat in the front end case, a construction which provides ample adjustment for the brushes, and by doing away with the rocker arm, makes the commutator and brushes quite easy of access. The doors are hinged on the front bearing. It is claimed that these motors show an unusually low heat loss for machines of this type. They have been found to meet the rigid requirements of the United States Navy, being used extensively for navy-yard and ship-board work.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was obtainable with comparative freedom, the closing rates being 5 per cent. for 30 to 60 days; 4½@5 per cent. for three, four, five and six months. In the stock market speculation was very dull and depressed owing to the coal strike. Early in the week there was some firmness, but toward the end prices fell off and the volume of business decreased to very small proportions, the absence of commission business being a noticeable feature. The anthracite coal stocks were naturally objects of much attention, and when the announcement was made that the strike of the miners would be continued there was heavy selling. The industrial specialties were for the most part dull. The steel stocks were well supported, but not particularly active. Amalgamated copper was more active and advanced from 66⅝ to 69 on the increased exports and the advance in the price of copper. Trading in other prominent industrials was on a limited scale. Electric stocks and tractions were weak, all, without exception, closing at figures lower than those last quoted. General Electric lost 6 points, closing at 315, and Westinghouse common 8, the last quotation being 208. The 1st pfd. closed at 218, which is a net loss of 1½. In the traction list, Brooklyn Rapid Tran. closed at 64¾, a net loss of 1⅛ points, and Metropolitan at 146¾, a drop of 2¼ points. Weakness also prevailed in the telegraph and telephone list, Am. Tel. and Tel. closing at 180, a net loss of 1½; Western Union 89½, a loss of 2½, and Am. Tel. and Cable 91⅝, a net loss of ⅜. American Dist. Tel. closed at 40, which quotation is ¼ point above the last. In Boston the week closed dull and uninteresting. Following are the closing quotations of May 20:

NEW YORK.

	May 13.	May 20.		May 13.	May 20.
American Tel. & Cable.	92	90	General Carriage	3	2⅜
American Tel. & Tel.	178¼	177	Hudson River Tel.	—	—
American Dist. Tel.	38½	38	Metropolitan St. Ry.	147¼	148
Brooklyn Rapid Transit	65⅜	66	N. E. Elec. Veh. Trns.	—	1¼
Commercial Cable	155	161½	N. Y. E. V. T. Co.	13½	13⅝
Electric Boat	34	28	N. Y. & N. J. Tel.	—	166
Electric Boat pfd.	48	48	Tel. & Tel. Co. Am.	—	—
Electric Lead Reduc'n	—	3	Western Union Tel.	91¼	90
Electric Vehicle	7	5	West. E. & M. Co.	209½	212
Electric Vehicle pfd	13	11½	West. E. & M. Co. pfd.	209	—
General Electric	319¾	316¼			

BOSTON.

	May 13.	May 20.		May 13.	May 20.
American Tel. & Tel.	178	178	Mexican Telephone	2¼	2¼
Cumberland Telephone.	—	—	New Eng. Telephone	149*	146
Edison Elec. Illum.	—	—	Westinghouse Elec.	—	—
Erie Telephone	—	—	Westinghouse Elec. pfd.	—	—
General Electric pfd.	—	315			

PHILADELPHIA.

	May 13.	May 20.		May 13.	May 20.
American Railways	—	46	Phila. Traction	97½	97½
Elec. Storage Battery.	85	87½	Phila. Electric	5¼	5¼
Elec. Storage Bat'y pfd.	84½	87½	Pa. Elec. Vehicle	—	1¼*
Elec. Co. of America	—	7⅛	Pa. Elec. Vehicle pfd.	—	4*

CHICAGO.

	May 13.	May 20.		May 13.	May 20.
Central Union Tel.	—	—	National Carbon pfd.	91*	91¾
Chicago Edison	172½	174	Northwest Elev. com.	37	—
Chicago City Ry.	215	—	Union Traction	19½	18¾
Chicago Teleph. Co.	—	—	Union Traction pfd	54	—
National Carbon	25½	25¼	*Asked.		

MANHATTAN TRANSIT COMPANY.—With regard to the affairs of the Manhattan Transit Company recently formed to cooperate with the General Carriage Company, the *Wall Street Journal* has the following data as to what the versatile Mr. J. H. Hoadley proposes to do: A new corporation—the Manhattan Transit Co.—will take over all the assets of the old corporation, and also the old Gambrinus brewery at Forty-second Street and Second Avenue, which Mr. Hoadley purchased from Mr. Morgan about five months ago, and has since stocked with several hundred vehicles of all kinds, including 200 vehicles purchased from the New England Electric Vehicle Company at a very small price. In this factory a carpenter shop, machine shop, electric battery room, charging room, repairing room, carriage trimming department and wheel shop have been fitted up, and several hundred workmen are now engaged in putting into order the abandoned electric vehicles which Mr. Hoadley has been for some months picking up, feeling sure that he had a revolution in the power industry. Mr. Hoadley says that he can charge these electric vehicles through fuel oil, and the Diesel engine at two mills per kilowatt hour, while the present charge in New York for electric current is twelve cents per kilowatt hour. Mr. Hoadley figures he will have an abundant profit at one-tenth the existing rates of charging electric batteries. He is also turning out steam trucks, in the development of which he has spent $600,000. He claims that in this line he has produced a steam engine of sixteen pieces without a bolt or a screw, and that he will be turning out five steam trucks a week by the first of September.

MANHATTAN RAILWAY.—It is reported that earnings for the current quarter will show about as large an increase as was shown for the quarter ended March 31. It is asserted very positively that the increase in business is the result of the very satisfactory service maintained rather than of the torn-up condition of certain streets forcing business away from the surface cars. The secret of the gain is believed to be the fact that trains are kept running with strict regularity, absolutely on schedule time. Formerly it took trains, say 20 minutes to run from Chatham Square to South Ferry. Now the run is made in less than half the time, and the same is true of approaches to all terminals where trains had been allowed to obstruct one another. The result of such obstruction in the past was that every day trains had to be withdrawn on account of the difficulty of getting them away on schedule time. Now anything of this kind is unknown. Every train provided for on the time sheet runs its full number of trips and runs them exactly on schedule time. Some recent days, when traffic conditions were perfectly normal, have shown a total number of passengers carried which came comparatively near the high record figures of 1893. The extension of electric operation to the Fordham Extension is expected to result in a considerable increase in business in the Bronx, and it is predicted that with all lines in electrical operation the company is likely to do a business of 1,000,000 passengers per day.

DENVER TROLLEY FINANCING.—A circular has been sent out to the stockholders of Denver City Tramway, signed by the president of the company and three large stockholders, stating that 78 per cent. of the stock had been turned in to Denver & Northwestern. Under this plan stockholders may take cash par value for the stock turned in before June 2, or they may take for every $500 of stock an equal amount of thirty-year 5 per cent. first and collateral mortgage bonds and $125 of stock of Denver & Northwestern. By this plan, Denver & Northwestern constitutes itself a holding company, issuing $6,000,000 bonds to take up the $5,000,000 stock of Denver City Tramway. This stock is the only security behind these bonds and the dividends on this stock are the source from which the 5 per cent. interest on the bonds must be drawn. The stock has been paying 4 per cent., and has been said to be able to pay 6 per cent. This latter dividend would just pay the interest on the bonds. The assets of Denver & Northwestern outside of these dividends consists of four miles of road running to a coal field, and a prospective local coal delivery trade in the city of Denver. This is expected to do away with the retailers and middlemen by supplying the wants of the town by direct delivery from the mines to the consumer. A vigorous resistance is looked for on the part of the retail trade. The total capital stock of Denver & Northwestern is $6,000,000 exclusive of the bonds.

LONDON TUBES.—As to underground railway developments in London, a cable dispatch of May 17 says: The Morgans are much satisfied with the decision of the House of Lords' committee granting them the right to construct a "tube" railroad from Hammersmith to Tottenham, about fourteen miles, passing through the heart of the City, via Piccadilly. The committee's decision now goes to Parliament for confirmation. The only applications refused Mr. Morgan were facilities to build two small lines at either end of the present terminal, which are already connected with over 100 miles of street-car track. Charles T. Yerkes has also been successful. But the English authorities believed that his proposed "corkscrew" line, from Charing Cross to Piccadilly, was not feasible. Hence the refusal to allow its construction. Mr. Yerkes now has a circle on both sides of London, while Mr. Morgan runs in the center and to the north.

CHICAGO LIGHTING.—In connection with the recent announcement of a community of ownership between the Peoples Gas Light and Coke Company and the Northwestern Gas Light and Coke Company of Evanston, there is believed to be a $100,000,000 combination in process of formation, embracing the principal gas and possibly electric lighting plants in Chicago and neighborhood. It is said that the purpose of the company is to effect a virtual consolidation of the Northwestern Gas Company of Evanston and the Peoria Gas and Electric Light Company, the Highland Park Electric lighting plant, the Blue Island and Cicero gas plants.

GENERAL CARRIAGE.—Details of the plan by which the Manhattan Transit Company, incorporated at Albany last week with a capital stock of $10,000,000 in shares of $20 par value, will effect the reorganization of the General Carriage Company, have been made public. The stockholders of the General Carriage Company of New Jersey have the privilege of depositing their stock with the Atlantic Trust Company, accompanied by a cash payment of $2 a share. In exchange they will receive for each share of stock deposited one share of the stock of the Manhattan Transit Company. The company is also to issue $800,000 of fifty year 4 per cent. bonds. It is to acquire besides the $400,000 raised by the assessment on the General Carriage stock, the real estate, subject to mortgage, at Forty-seventh Street and Second Avenue; the capital stock of the carriage company covering the franchises of that company; 150 automobile vehicles, and the exclusive right for the State of New York for the use of the auto trucks manufactured by the International Power Company. It will be remembered that the company gave notice recently of its ownership of a number of the patents of R. M. Hunter. This was at the time the stock made its sensational slump.

NEW ORLEANS CONSOLIDATION.—Plans have now been completed for the merging under the name of the New Orleans Railways Company of all the electric railways, gas and electric light companies of New Orleans, La. The companies absorbed are the New Orleans City Railroad, New Orleans and Carrollton Railroad, Light and Power Company, Orleans Railroad Company, New Orleans Gas Light Company, New Orleans Lighting Company, and the New Orleans Railways Company. The new concern is being capitalized as follows: Fifty year 4½ per cent. sinking fund gold bonds, $40,000,000, of which $20,000,000 is being issued now to acquire existing securities; $7,154,000 is reserved for future extensions and improvements, and the remainder is reserved to retire existing bonds as they mature or are exchanged; 4 per cent. cumulative preferred stock, $10,000,000; common stock, $30,000,000. The syndicate is being organized under the management of the New York Security and Trust Company to underwrite the exchange of the securities. The participation syndicate subscribers receive for each $1,000 subscribed, in addition to a commission, $769.23 in 4½ per cent. bonds, $384.51 in preferred stock, and $769.23 in common stock.

CONSOLIDATION OF OHIO RAILWAYS.—The final steps have been taken for the consolidation of the Southern Ohio Traction Company, the Cincinnati Northwestern Railway Company, the Miamisburg and Germantown Traction Company, and the Hamilton and Lindenwald Electric Transit Company. The consolidated company will be known as the Cincinnati, Dayton and Toledo Traction Company. The capital stock is $5,000,000 and bonds of like amount will be issued, of which $2,300,000 will be retained in the treasury to retire underlying bonds. There will be issued to retire the Southern Ohio Traction stock, $1,200,000, and there will be retained in the treasury, for future extensions, consolidations, etc., $1,500,000.

BANNER ELECTRIC COMPANY.—At a meeting of the stockholders of the Banner Electric Company, of Youngstown, O., held at their offices on May 12, it was decided to increase the capital stock of the company from $35,000 to $50,000. This action was made necessary on account of the rapidly increasing business of the company, thus necessitating the enlarging of its plant and equipment. The Banner Electric Company has been in operation since November 1. The officers of the company are: J. Evans Lippincott, president; Thos. Carr, vice-president; O. U. Cassaday, treasurer; N. L. Norris, secretary and general manager; F. C. Kirchner, superintendent.

FESSENDEN WIRELESS TELEGRAPH COMPANY.—It is reported from Pittsburg that Prof. Reginald A. Fessenden, who has been conducting experiments in wireless telegraphy in behalf of the United States government, has completed arrangements for the organization of a $5,000,000 company to develop his system. It is also stated that Prof. Fessenden has arranged to fulfil a number of contracts of importance. He and his associates will shortly take up the work of installing transatlantic stations, connecting, in one instance, the United States with France.

WEST END STREET RAILWAY.—Stockholders of the West End Street Railway Company, at a special meeting, on May 21, voted to authorize the directors to issue $300,000 4 per cent. 15-year bonds, dated August 1, 1900, to repay the Boston Elevated the amount advanced by it to pay the principal of the $300,000 Highland Street Railway 5 per cent. bonds which matured May 1, 1902. Stockholders also authorize the directors to issue additional bonds from time to times as may be required by the terms of the lease to the Boston Elevated.

GENERAL ELECTRIC BOARD.—At the annual meeting of the General Electric Company, held at Schnectady, N. Y., on May 15, the following board of directors was re-elected for the coming year: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., Frederick P. Fish, George P. Gardner, Eugene Griffin, Henry I. Higginson, J. Pierpoint Morgan, J. P. Ord, Charles Steele, Robert Treat Paine, 2d, and George Peabody. About 185,000 shares of stock were represented at the meeting.

GRAND RAPIDS ELECTRIC LIGHTING PROPERTIES.—A syndicate of Cincinnati, Chicago and Grand Rapids capitalists has purchased the properties of the Edison Electric and Grand Rapids Electric Light and Power Companies, of Grand Rapids, Mich. The capital is $1,000,000, and $610,000 in bonds is being issued.

REDUCING CAPITAL STOCK.—The International Bell Telephone Company, Limited, of New York City, of which Charles J. Bell, S. D. Babcock, Charlton T. Lewis, Fred M. Thieriot and D. H. S. Randall are directors, has certified to the Secretary of State that its capital has been reduced from $500,000 to $250,000.

GENERAL ELECTRIC.—It is stated that the subject of capital readjustment will be taken up by the directors some time next month. A stock dividend of 66⅔ per cent. will call for the distribution of $16,761,000 of new stock of the issue of $19,757,800 recently authorized by stockholders.

DIVIDEND.—The Philadelphia Electric Company has declared a dividend of 15 cents, payable June 16.

Commercial Intelligence.

THE WEEK IN TRADE.—Among the conditions governing trade, Bradstreet's points out that there is a lack of uniformity, which explains irregularity in advices from different sections. The preeminent feature, however, is the favorable character of nearly all crop advices. The shadow overhanging Eastern trade in the shape of a general anthracite coal strike has deepened with the formal suspension of work and the strike announcement. The industrial outlook, aside from the anthracite trouble, and the possibilities of this disturbance, if extended, involving some branches of the iron and steel trades, is, on the whole, no more unsettled than might be expected in a time of more than ordinary prosperity. Reports of railroad earnings for the first week of May indicate a gain in excess of 8 per cent. Activity continues in nearly all kinds of building materials, despite the largest production of pig iron on record, at the rate of 18,000,000 tons a year. Bessemer pig is advancing, the increase for the six months being $6 per ton. Sales of Southern iron are also reported at advanced figures. Large structural orders have been placed for 1903. The business failures during the week, as reported by *Bradstreet's*, aggregated 190, as against 179 the week previous, and 192 the same week last year. The copper market is very firm, the manufacturers in this country being very busy. It is reported that a number of large producers have sold their products for the near future, and it is believed that buyers have not yet filled their entire requirements. Prices are somewhat improved, Lake being quoted at 12⅛@12¼c., electrolytic in cakes, wire bars and ingots at 11¾@11⅞c., cathodes and casting stock at 11½@11⅝c.

SHAW CRANES FOR SUBWAY POWER STATION.—The Shaw Electric Crane Company, of Muskegon, Mich., has just secured a substantial contract for cranes, which are intended to be installed in the New York rapid transit subway power station, to be erected on Eleventh Avenue between Fifty-eighth and Fifty-ninth Streets. The contract calls for a crane of 60-tons capacity together with two 50-ton trolleys, for a span of 75 feet. The height of the hoist will be 80 feet. This outfit will be operated by a 175-hp motor of Shaw make. A 25-ton crane, together with a 5-ton auxiliary hoist, has also been requisitioned for. This machine will be driven by a 60-hp Shaw motor. Both of these cranes will be run on the same track. The value of the contract is close on $25,000.

THE GOUDEY-McLEAN COMPANY, of 88 Maiden Lane, New York, which concern acts as foreign sales managers for a number of electrical firms throughout the country, has just been forwarded by its Scottish branch—the Scottish Goudey-McLean Company, Limited, of Glasgow—a number of orders for motors, ranging from 5-hp to 10-hp each. These motors will be built by the Browning Manufacturing Company, of Milwaukee, Wis., and the Milwaukee Electric Company. Some of them are intended to be installed in Glasgow newspaper offices. Legendré Fréres, of Paris, which concern represents the Goudey-McLean people in France, have also sent in a fair sized contract for motors.

NEW ZEALAND CONTRACTS PENDING.—The Auckland (New Zealand) city council has retained Noyes Brothers, of Sydney, to act as consulting engineers respecting the electric lighting of the city of Auckland. It is also proposed to operate the cranes on the wharves by electricity. The municipality of Wellington will shortly let contracts for the construction of an electric traction system.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended May 10: Antwerp—37 pkgs. material, $2,519. Argentine Republic—8 pkgs. material, $1,442; 1 pkg. machinery, $670. Amsterdam—1 pkg. machinery, $91. Alicante—1 pkg. material, $25. Bradford—9 pkgs. machinery, $700. Brazil—22 pkgs. machinery, $1,161; 82 pkgs. material, $3,223. Barcelona—5 pkgs. machinery, $284. British East Indies—41 pkgs. material, $978; 7 pkgs. machinery, $752. British Possessions in Africa—1 pkg. material, $100. British Australia—4 pkgs. material, $346. British West Indies—25 pkgs. machinery, $295. Cuba—153 pkgs. material, $9,518. Charkow—4 pkgs. machinery, $350. Central America—95 pkgs. material, $674; 51 pkgs. machinery, $8,742. Copenhagen—1 pkg. material, $105. Christiana—1 pkg. machinery, $75. Ecuador—9 pkgs. material, $204. Genoa—25 pkgs. material, $500. Glasgow—9 pkgs. material, $167; 11 pkgs. machinery, $1,080. Havre—9 pkgs. material, $350. Hayti—4 pkgs. material, $47. Hong Kong—4 pkgs. material, $2,687. Hamburg—5 pkgs. machinery, $607; 21 pkgs. material, $2,411. Hull—4 pkgs. material, $90. Japan—4 pkgs. material, $55. London—80 pkgs. material, $5,720. Liverpool—149 pkgs. machinery, $13,321; 22 pkgs. material, $1,217. Leeds—1 pkg. material, $20. Manchester—556 pkgs. machinery, $99,264. Milan—27 pkgs. material, $588. Mexico—4 pkgs. material, $104. Naples—1 pkg. material, $50. New Castle—1 pkg. material, $19; 8 pkgs. machinery, $1,976. New Zealand—2 pkgs. machinery, $86. Nova Scotia—19 pkgs. material, $278. Peru—18 pkgs. material, $872. Philippines—5 pkgs. machinery, $342. Rotterdam—5 pkgs. machinery, $120. Rome—59 pkgs. machinery, $10,000. U. S. Colombia—8 pkgs. material, $151. Venezuela—53 pkgs. material, $710.

LIGHTING EQUIPMENT FOR PHILIPPINE CRUISERS.—The fifteen cruisers which are now undergoing construction in Chinese and Japanese shipbuilding yards for coasting and inter-island service in the Philippines, are to be each equipped with 10-kw marine-type lighting sets and 18-inch searchlights. The General Electric Company has secured the contract, which is valued at nearly $40,000. The duplex pumping equipments of these vessels are to be supplied by the Laidlaw-Dunn-Gordon end of the International Pump Company. These contracts have been placed by F. W. Horne, of Yokohama, the pioneer handler of American machinery in the Far East, who is now in the United States for the purpose of placing contracts aggregating nearly a quarter of a million dollars, for various electrical equipments, machine tools, etc. The contract for the wiring for the cruisers has not yet been let. This item will represent an expenditure of about $10,000. Mr. Horne has also some interesting orders to place for equipment needed in several of the Japanese arsenals. He is making his headquarters at the offices of W. J. Kingsland, in the Curtis Building, 35 South William Street. Uptown he can be found at the Hotel Manhattan.

WESTINGHOUSE EQUIPMENT FOR NEW AUSTRALIAN ROAD.—The Australasian electrical engineering and contracting firm of Noyes Brothers, which concern represents the Westinghouse interests in the Antipodes, has secured the contract for the equipment of Adelaide electric traction system. The lines will be about 66 miles in length. The value of the contract is over $3,500,000. Under the measure passed by the South Australian House of Parliament, 42 miles of electric traction must be in operation within three years. The existing horse tramways, owned by various companies, are to be acquired at a cost of between $1,750,000 and $2,000,000. The new Adelaide system will be built and operated, for a certain period, by a private enterprise, differing in this respect from the Sydney system, which is being constructed and worked by the New South Wales Government. Fourteen years after construction the municipality of Adelaide has the right to acquire the projected road at valuation, and in 55 years the lines are to become the property of the local authorities free of cost.

MASSENA POWER.—It is announced that the Pittsburg Reduction Company has secured 100 acres of land at Massena, N. Y., and will at once erect five large factories to cover at least fifteen acres of its land. The company will manufacture aluminium principally, and will employ from five to six hundred men steadily the year round. This company has plants at Niagara Falls, Shawinigan Falls, Quebec and Pittsburg. The Massena factories will be one of their main plants on account of the cheap shipping facilities both by water and rail and the abundant electrical power available at a low cost. The cost of this plant will involve an expenditure of over $1,000,000. The buildings will be inclosed by Fall, and the works in operation by April of next year.

WATER-POWER PLANT FOR COSTA RICA MINES.—The Abangarez Gold Fields of Costa Rica, an Anglo-American concern, in which Mr. Minor C. Keith, vice-president of the United Fruit Company, is largely interested, has placed contracts for a water-power plant to operate its mines in Central America. Hitherto work has been carried on by means of steam power. The water-power plant is to have an initial capacity of 300-hp, which is expected to be largely added to in the near future. The electrical portion of the contract has been undertaken by the General Electric Company. The water-wheel equipments will be furnished by the Pelton Water Wheel Company. The Pelton Company has also secured an order for 1½ miles of pipe.

ORDERS FOR AUTOS.—The Vehicle Equipment Company, of Brooklyn, has been compelled to enlarge its plant, and for that reason has acquired a portion of the old De Dion plant, adjoining the Nassau car stables, Thirty-seventh Street and Thirteenth Avenue, now occupied by the former concern. The Rainier Company, of 393 Broadway, agents of the Vehicle Equipment Company, have just sold, among others, a 5-ton electric truck, with electric hoisting apparatus, to the Niles-Bement-Pond Company, in Liberty Street; a 4-ton truck to the John Simmons Company, at 110 Centre Street, and an electric delivery wagon to Schonniger Bros., the milliners.

DIESEL ENGINE.—At a meeting of the directors of the American Diesel Engine Company, Hugo Reisinger resigned as secretary and treasurer, and Edwin S. Cramp, vice-president of the Cramp Ship Building and Engine Company, of Philadelphia, was elected a director. President Busch has visited the works of the International Power Company, at Providence, where the Diesel engines are being manufactured, and is said to be very much pleased with the new engines which are being built with all the improvements put on by the International Power Company. The International Power Company holds the manufacturing right for Diesel engines in the United States, Canada, Great Britain and all her colonies.

STEEL FOR SYDNEY POWER STATION.—Milliken Brothers, New York, are about to make shipment, through R. W. Cameron & Company, New York, the American agents of the New South Wales Government, of some 700 tons of structural material, which will be used for an extension to the central power station of the Sydney City and Suburban Tramways. It will be recalled that the General Electric Company was awarded the contract for the initial equipment of the power house, etc., valued at nearly $800,000. Further important contracts will be awarded shortly.

ELECTRIC POWER IN ELECTROTYPERS.—Electrotypers and photo-engravers have been quick to see the advantages of electrically-driven machines, and are installing electric motors in their plants as rapidly as occasion permits. One of the most recent plants to be thus equipped is that of the United States Playing Card Company, Cincinnati, O., where all the electrotyping and photo-engraving machines are operated by the Sprague Electric Company's motors.

ELECTRICAL PLANT FOR QUEENSLAND RAILWAY SHOPS.—The Queensland Government's new railway shops at Ipswich, are to be installed with a complete electrical plant, for the purpose of operating machine tools, etc. The plant will consist of three 250-hp Westinghouse engines and two-phase generators, switchboard, steam piping, pumps and several motors for driving the machines.

MEXICAN POWER HOUSE CONTRACTS.—The Riter-Conley Manufacturing Company, of Pittsburg, Pa., has secured the contract for the extension of the boiler and engine house of the Mexican Tramways Company, Limited, City of Mexico. The same concern has also received the contract for the erection of the power plant of the Compania de Penoles, at Mapina, Mexico.

MR. A. K. BAYLOR, formerly connected with the railway department of the British Thomson-Houston ompany, Limited, and now interested in the British Electric Car Company, is at present on a visit to the United States. He may be found at his New York office in the Bowling Green Building, or at the Hotel Albemarle.

THE VALLEY SUGAR COMPANY, which is building a beet sugar plant at Carrollton, Mich., will have an electric plant, consisting of two engines built by the Ball Engine Company, Erie, Pa., direct connected to Crocker-Wheeler generators.

A PRISON LIGHTING PLANT.—Warden George Deyo of Clinton Prison, Dannemora, will purchase a 100-kw. alternating current plant for lighting Clinton prison. Mr. Robert Elliott is electrical engineer of the prison.

LORAIN RAILS FOR ENGLISH ROAD.—The Lorain Steel Company has secured a contract for track material for the electric traction system about to be constructed by the Corporation of Reading, England.

MEXICO ROAD TO BE EXTENDED.—The electric system at Puebla, Mexico, which is controlled by the Mexican Tramways Company, Limited, City of Mexico, is to be extended.

General News.

THE TELEPHONE.

MOHAWK, ARIZ.—It is reported that the telephone system comprising 75 miles of lines operated by G. W. Norton will be extended to Harqua Hala.

SAFFORD, ARIZ.—The Gila Valley Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-restoring drop board.

LOS ANGELES, CALIF.—The New Home Telephone Company, of Los Angeles, has 6,000 subscribers. It has just received 210,000 feet of conduit cable, which will be laid as fast as conduits are built.

DENVER, COLO.—The Colorado Bell Telephone Company is preparing to duplicate enough of its Denver-Cheyenne service to make a more complete and extended service between Denver and Salt Lake City.

GUNTERSVILLE, FLA.—J. C. Drake will construct a telephone system from this place to Joppa.

AUGUSTA, GA.—The Augusta Telephone Company has increased its capital stock to $30,000.

HENRY, ILL.—The Hopewell Telephone Company has petitioned for a franchise in this place.

TOULON, ILL.—The Stark County Telephone Company has increased its capital stock from $5,000 to $6,000.

MACOMB, ILL.—The Illinois Western Telephone Company has increased its capital stock from $60,000 to $200,000.

CHICAGO, ILL.—The Flanagan & Dana Telephone Company, of Flanagan, capital $980, has been incorporated by Henry P. Thompson, George Crawford, Milton M. Bane.

RODNEY, IA.—The Monona Telephone Company will build a line from this place to Ticonia.

EAST MOLINE, IA.—The Crescent Telephone Company is building a line from Osborn to this place.

HEDRICK, IA.—The Hedrick Telephone Company's franchise has been granted. The company will now greatly enlarge its system.

SPENCER, IA.—A special election will be held soon to decide upon the granting of a franchise to the Clay County Telephone Company.

DAVENPORT, IA.—There is a probability that the Iowa Telephone Company will build a line from this city to Plainview and Marysville.

RED OAK, IA.—The Red Oak Mutual Telephone Company has incorporated, with a capital stock of $10,000. William Cozal is president.

CEDAR RAPIDS, IA.—The Farmers' Telephone Company, of Cushing, Woodbury county, has filed articles of incorporation. Its capital stock is $6,000.

CEDAR FALLS, IA.—The Rapid Transit Company is installing a telephone system on its interurban cars running between this city and Waterloo and that city and Denver.

MILTON, IA.—The Milton Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company for a 150-line magneto self-restoring drop switchboard.

MARSHALLTOWN, IA.—The Marshall Telephone Company, of this city, has executed a mortgage of $20,000 in order to provide for extensive improvements to the system, including a new switchboard and the laying of underground cables.

MUSCATINE, IA.—The American Telephone & Telegraph Company has, within the past six weeks, secured franchises in the following-named places: Wapello, Burlington, Ft. Madison and Keokuk, Ia., and La Grange, Hannibal, Bowling Green, Troy and St. Charles, Mo. A franchise for this city will probably be granted to the same company.

GAYLORD, MICH.—The Otsego Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company for a 200-line self-restoring drop switchboard.

WADENA, MINN.—The Iron Range Electric Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 200-line self-restoring drop board.

PATMOS, MISS.—The Deer Creek Telephone Company has incorporated, with a capital of $600. H. G. Thornell and others are interested.

GREAT FALLS, MONT.—The Rocky Mountain Bell Telephone Company will at once start construction on a new line from Great Falls to Fort Bemoi, a distance of 50 miles.

RENO, NEV.—The Sunset Telegraph & Telephone Company is endeavoring to obtain 300 more subscribers for the Reno exchange, in which case a new exchange will be put in and the express system installed. The company will at once start extending to a number of other Nevada towns.

WACO, NEB.—The Waco Telephone Company has incorporated, with a capital stock of $5,000. J. A. Gilbert is president.

EAST AURORA, N. Y.—The Haines Telephone Company has been incorporated, with a capital stock of $20,000.

AMSTERDAM, N. Y.—The Hudson River Telephone Company contemplates erecting an exchange building here soon.

TROY, N. Y.—The New Lebanon Farm Telephone Company, of Otsego county, has been incorporated. The capital stock is $5,000.

FARGO, N. D.—The Formen Telephone Company has been reorganized under the name of Great Western Telephone Company, with a capital of $100,000.

RIPLEY, OHIO.—The Ripley Telephone Company has been granted a franchise to establish a local exchange and a toll station in the village of Shreve.

BERLIN, OHIO.—The Berlin Telephone Company of Holmes County has increased its capital stock from $1,350 to $4,500 to provide for improvements.

DEFIANCE, OHIO.—C. R. White, D. Lieberthal, John Titus and others of Defiance have secured a franchise for an independent telephone system in Ashland.

FLUSHING, OHIO.—The Flushing Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-restoring drop board.

MANSFIELD, OHIO.—A lively fight is on between the Central Union Telephone Company and the Mansfield Telephone Company, which has recently commenced operations.

KENTON, OHIO.—The Kenton Telephone Company is installing an addition to its switchboard to take care of numerous new subscribers. A number of new rural lines is being built.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has 470 telephones in operation and orders which will bring it over the 500 mark. A switchboard addition has been ordered.

ALLIANCE, OHIO.—The physicians of Alliance have signed an agreement to discontinue the use of Bell telephones after June 1. It is understood they will subscribe for the new independent service.

CHILLICOTHE, OHIO.—The Chillicothe Home Telephone Company is installing considerable cable work and a new switchboard and will build a number of farmers' lines. At present it has over 1000 subscribers.

TOLEDO, OHIO.—Spitzer & Company have acquired a large financial interest in the Toledo Home Telephone Company and Gen. C. M. Spitzer has been chosen a director in the place of C. F. Chapman, who recently resigned.

SEBRING, OHIO.—The Central Union Telephone Company is installing a local exchange, and will furnish business lines at $2 and residence lines at $1 per month. Free service is given to Alliance and surrounding towns.

LORAIN, OHIO.—The Lorain Telephone Company has placed a contract with Arthur W. Hoge for a switchboard of 4,000 drops. New conduits will be laid and additional telephones purchased. The improvements will cost about $65,000.

NAPOLEON, OHIO.—After a fight of more than a year, the Central Union Telephone Company has been refused a franchise in Napoleon by the Probate Court, on the ground that more telephone wires on the street would be a serious obstacle in case of fire.

COLUMBUS GROVE, OHIO.—The Putnam Telephone Company is making important improvements at Columbus Grove, Continental and Pandora. The new switchboard for Columbus Grove is being built by the Columbia Telephone Manufacturing Company of Ottawa, Ohio.

DEFIANCE, OHIO.—The Northwestern Telephone Company has elected these officers: H. B. Tenzer, president; William Geiger, vice-president; W. W. Wood, secretary, and W. G. Lehman, treasurer. The annual report shows a gain of over 200 subscribers for the year. The company is planning extensive improvements to its system.

HASKINS, OHIO.—The Haskins Mutual Telephone Company has organized as follows: F. A. Robertson, president; J. A. Bowers, vice-president; E. C. Thornton, secretary-treasurer; Wm. Mohr, general manager. The above with E. C. Thornton, John Schurtzburg and Fred Dauer are directors. The exchange will shortly be placed in operation and connection will be made with Bowling Green, Weston, and other points.

AKRON, OHIO.—Manager Laubach of the Akron People's Telephone Company states that it now has over 3,000 telephones connected up in Summit county. The increase amounts to 50 per cent in the past six months and 100 per cent in the past year. The company is planning to build several subexchanges in the southern portion of the county and will cover the territory thoroughly with farmers' lines.

EAST LIVERPOOL, OHIO.—The telephone operators in the exchange of the Columbiana County Telephone Company struck for an increase in pay a few days ago. They demanded an increase from $20 per month to $1 per day. The girls finally returned to work on the following scale: Toll operators, $1 per day; three oldest operators, $25 per month; other operators, $20 and $21; overtime, 10 cents an hour, and each operator to be given a ten-days' vacation with full pay.

MT. VERNON, OHIO.—The Mt. Vernon Telephone Company held its annual meeting a few days ago and elected directors as follows: F. L. Beam, H. C. Devin, P. S. Kelser, B. L. McElroy, W. P. Bogardus, A. R. Sipe and B. D. Herron. During the past year the company has spent $8000 in improvements and it is contemplating a large amount of work for this summer. A new exchange will be installed at Centerburg with equipment for 100 subscribers. Over 800 telephones are now in operation in the county.

CIRCLEVILLE, OHIO.—The Circleville Citizens' Telephone Company was organized a year ago and commenced business in September with 35 subscribers connected. At present the company has in actual operation 596 telephones divided among three exchanges as follows: Circleville 418; Ashville, 99 and Williamsport 79. The company has over 100 miles of toll line reaching twenty-four towns. An order has been placed for an additional switchboard and new lines are to be built to Yellow Bud, East Ringgold, Commercial Point and Matville. A number of farmers' lines are to be built.

JOHNSTOWN, PA.—The Johnstown Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-restoring drop board.

DALLAS, PA.—The Centre Moreland Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-restoring drop switchboard.

SOUDERTON, PA.—A number of capitalists of this place have formed the Wheatstone Bridge Telephone Company, with a capital of $500,000, and will install a telephone system in the farming section of Worcester township.

NASHVILLE, TENN.—The Cumberland Telephone Company, of Nashville, Tenn., has bought the Carroll County Telephone Company, with lines and exchanges in McKenzie, Hollow Rock, and other points.

BEAUMONT, TEX.—The Beaumont & Northwestern Telephone Company has increased its stock from $10,000 to $20,000.

HENRIETTA, TEX.—The Farmers' & Merchants' Telephone Company has increased its capital stock from $2,400 to $4,800.

HERNDON, VA.—E. L. Detwiler has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-restoring drop board.

SALT LAKE CITY, UTAH.—The Gila Valley Telephone Company of Arizona will at once extend its lines. The company will build from Tombstone to Pearce, Turquoise, Cochise and Willcox, and from that point to Solomonville and Safford. The Globe Telephone Company of Arizona will build across the San Carlos Indian reservation to connect with the lines of the Gila Valley Company at Fort Thomas.

RICHMOND, VA.—The Street Committee has adopted an ordinance granting the Richmond Telephone Co., of Richmond, two years in which to place its wires under ground. The officers of the company asked for ten years.

ST. ALBANS, VT.—The Franklin County Telephone Company opened its exchange in St. Albans, Vt., February, 1900, with 100 subscribers. Today it has 500. Its business has steadily increased.

SPRAGUE, WASH.—A farmers' telephone company has been organized here to put in a system of country telephones in Whitman, Spokane, Adams and Lincoln counties. It is estimated that 100 miles of wire will be strung. The line will connect with the Inland Telephone Company.

ELECTRIC LIGHT AND POWER.

MARION, ALA.—The Marion Light & Power Company has been granted a forty-year franchise for an electric plant. T. D. Kemp, Selma, Ala., is secretary and manager.

PRESCOTT, ARIZ.—The Prescott Electric Company is expending $20,000 in the improvement of its electric lighting.

SAN FRANCISCO, CALIF.—The W. B. Brown Company has purchased a controlling interest in the North Bloomfield Mining Company, of Nevada county, Cal. Mr. M. B. Bourn is the president of the San Francisco Gas & Electric Company. It is considered more than probable that an electric generating plant will be installed for the transmission of electric power to San Francisco. The Bourn syndicate is also negotiating for the property of the Eureka Lakes Company, the owners of French Lake, fifty miles of ditches, canals, and valuable hydraulic ground at Columbia Hill and other points. The control of 10,000 inches of water is involved.

DENVER, COLO.—The new town of Custer, Colo., will at once install an electric light plant in connection with its water system.

CRIPPLE CREEK, COLO.—John P. Kerin has been granted a franchise by the City Council for electric lighting, power and heating.

BOULDER, COLO.—The two electric light and power companies are again cutting rates. Efforts at a consolidation have failed, and lights are being offered to citizens at 50 cents per month per ten-room house. The fight between the companies is being watched with interest, and citizens are taking lights of the company which offers them the cheaper.

JACKSONVILLE, FLA.—The Madison Electric Power Company, with $7,500 capital, has been incorporated by C. H. Smith, John C. Dial and M. D. Smith.

POCATELLO, IDAHO.—E. E. Calvin, George H. Olmstead and R. C. Sneed, Pocatello, have asked for an electric light and street railway franchise.

BOISE, IDAHO.—The Farmers' Grain Company, of Boise, recently incorporated, will build a power plant to operate its tramways. The company will also operate a telephone system from Nez Perces to surrounding towns.

BOSTON, MASS.—It is announced that the recent sale of the Plant Investment Company's trolley lines and electric light plant at Jacksonville, Fla., was to the Stone & Webster interests of this city. The companies comprised in this purchase will be united in a single corporation, and a considerable sum will be expended in developing properties.

TAUNTON, MASS.—It has been practically decided that Taunton is to have a new municipal lighting plant at an expense of $175,000, the Common Council and the majority of the board of aldermen being in favor of the plan. It is proposed to erect the new plant at Weir Village, on the Taunton River, and to use a portion of the power in conjunction with the pumping station of the new sewer system. Work will be begun at once on the new plant, the plans for which were drawn by Abner Coleman, manager of the lighting system.

ST. LOUIS, MO.—A contract for the construction of 4,250 feet of subway, 7x7 feet in dimensions, for conducting electric currents through various parts of the World's Fair site, was let recently to the Barwick Construction Company, it offering to do the work for $21,217. There were six other bidders: J. Monk, $21,350; Buehler-Cooney Construction Company, $22,305; Schilling & Sall, $23,250; R. W. Monson Company, $25,000; Carroll Contracting Co., $28,475, and A. Anderson, $31,568. The subway is to be constructed from the switchboard at the electricity building to the eastern end of the lagoons. It will have numerous branches conducting light and power circuits to all parts of the grounds.

LEBANON, OHIO.—The village of Lebanon will make improvements to its municipal lighting plant at an expense of $6,000.

FREMONT, OHIO.—The Home Light & Power Company has applied to the Council for a franchise to construct a new electric light plant.

TOLEDO, OHIO.—The Toledo Railway & Terminal Company will install an electrical plant for power and lighting in its new shops here.

CHILLICOTHE, OHIO.—The Chillicothe Electric Light & Power Company has ordered an automobile, to be used in the work of renewing carbons in arc lamps.

ELYRIA, OHIO.—The Elyria Gas & Electric Light Company has given bond for $5000 to guarantee the construction of the lighting and heating plant. Contracts for equipment are to be closed in the near future.

DOYLESTOWN, OHIO.—The project of building a lighting plant has fallen through, and the $10,000 raised by bond issue will be returned to the bond buyers. Failure to secure an electric railway caused the change in plans.

COLUMBUS, OHIO.—The City Council has purchased a site for a new municipal lighting plant, which will be equipped in duplicate, and have a capacity of 4,000 lamps. Machinery for 1,900 lamps will be installed at the start.

NAVARRE, OHIO.—Proposals will be received until June 5 by Will H. Sahl, corporation clerk, for the construction and operation of an electric lighting system, with not less than 30 arc lamps for a term of ten years. A franchise will be given to a new company.

LIMA, OHIO.—The Lima Electric Light & Railway Company has let contracts for the erection and equipment of its new power house. The building will be 100x125 feet. A 500-hp. generating set will be installed for lighting service, and a 600-hp. set for the railway service. About 800-hp. will be added to the boiler capacity. The improvements will cost about $800,000, and the structure will be ready about October 1.

OKLAHOMA CITY, OKLA.—Denver men, formerly connected with the Denver Gas & Electric Company, have secured one of the largest municipal contracts ever given in the Southwest. A. H. Brauch, formerly manager of the company, has been elected president of the Oklahoma City Gas & Electric Company, which will construct an electric light plant to light Oklahoma City and to furnish power for a street railway system, which will be built by St. Louis capitalists. Harry C. Nelson will be superintendent of the construction of the new plant.

ASTORIA, ORE.—The Astoria Electric Company will soon have a new power building, and will add a large boiler, engine and generator.

PORTLAND, ORE.—The Portland General Electric Company is increasing the capacity of its electric power plant in Portland by installing four 750-hp. generators.

CAMDEN, S. C.—The building of the Camden Electric Light, Water and Ice Company and two warehouses were totally destroyed by fire recently. The loss of the company is about $40,000, with no insurance.

MEMPHIS, TENN.—The Memphis Light and Power Company has been sold for a sum very nearly approaching one million dollars. The plant was bought in merely as an investment.

NASHVILLE, TENN.—The Cumberland Electric Light and Power Company, of Nashville, Tenn., has recently purchased ground and let the contract for a new electric light and power plant to cost $300,000.

LOGAN, UTAH.—Representatives of the Hercules Light & Power Company, of Logan, are in Soda Springs, Idaho, looking over the ground for a site for the new electric light plant.

SALT LAKE CITY, UTAH.—The O'Meara-Lynch Mining Company, of Utah, will install an electric power plant at its mine to run air compressors and furnish light for the mine.

BEAVER CITY, UTAH.—The City Council has granted a franchise to E. A. Hodges to install and operate an electric lighting system. The cost of the plant will be about $10,000.

SALT LAKE CITY, UTAH.—The Big Spring Electric Company, of Fountain Green, Sanpete county, Utah, has been incorporated; capital, $25,000. George Carter is president, A. J. Aagard, Jr., secretary and treasurer.

SALT LAKE CITY, UTAH.—Preliminary work on the new electric light plant at Ephraim, Utah, has started. As soon as this is done bids will be wanted for machinery and equipment. Mr. Hutchins, Ephraim, Utah, has charge of the work.

SALT LAKE CITY, UTAH.—The Brigham City (Utah) Electric Light & Power Company will build a new power plant, using the waters of the Box Elder Canyon. The plant will be located between the mouth of the canyon and Mantua, where a fall of 500 feet is available.

SALT LAKE CITY, UTAH.—Senator Clark will equip his Ophir (Utah) mine with electric power. A plant will be installed of sufficient capacity to operate the concentrating plant, light the mine and otherwise supply power. The new plant will have a capacity of about 300 horse-power.

PROVIDENCE, R. I.—Officials of the United Gas Improvement Company are negotiating to secure possession of the principal street railways and the electric lighting and gas plants of Providence. The companies being negotiated for are the Union Traction, the Narragansett Electric Lighting and the Providence Gas companies. The amount involved in the deal is $16,000,000.

MONTREAL, CAN.—A deal has been completed whereby the Lachine Rapids Hydraulic & Land Company contracts with the Shawinigan Water & Power Company for the distribution of its power throughout the island and city of Montreal. The arrangement is not an amalgamation of the companies, and does not affect the management of either, according to the statement of the officials. It is simply a contract which gives the Lachine Company right to call for a practically unlimited amount of power.

TOLUCA, MEXICO.—The work of constructing the great power plant of the Toluca Electric Light and Power Company near Tenancingo, Mexico, is making good progress. The machinery for the plant has just arrived at Toluca. It was purchased in New York City and weighs 6,000 tons. R. C. Bateman and M. T. Thompson, of the City of Mexico, have secured the contract for building the canal by which the water will be conducted from the San Pedro River to the plant. The company has secured contracts to supply electric lights and power to twelve towns situated in that region.

CITY OF MEXICO, MEX.—The annual meeting of the Compania Electrica e Irrigadora de Hidalgo, a Mexican corporation, was held recently in the City of Mexico. The report of President Thomas Braniff was presented. It showed the following receipts: From electric power contracts, $22,924.86;

irrigation contracts, $62,146.31; lighting the city of Pachuca, $47,587.55. Total receipts, $132, 658.72. The disbursements, ordinary and extraordinary, amounted to $130,794.96. The board of directors reported that the plant of the company is in first class condition and that it is expected that it will be able to pay a fair dividend this year. Captain Pord Porfirio Diaz, Jr., son of President Diaz, and Mr. Constantine Noreiga were elected auditors for the current year.

THE ELECTRIC RAILWAY.

WILLIAMS, ARIZ.—The Williams & Cataract Canyon Railroad Company, recently incorporated by A. L. Hall, A. B. Coit and others of 71 Broadway, New York City, will construct in addition to a railway, telegraph and telephone lines and an electric power plant. The capital stock of the company is $3,000,000 and the power will be transmitted to Williams.

JERSEY CITY, N. J.—The North Jacksonville Street Railway, Town & Improvement Company has been incorporated here; capital, $150,000. Incorporators—R. R. Robinson, F. D. Robba, George E. Ross, J. L. Muse, William H. Young, F. P. Pratt, Frank P. McDermott.

COLUMBUS, OHIO.—The Chamberlain bill, authorizing street railways to consolidate with artificial and natural gas companies, has become a law.

LIMA, OHIO.—The council has granted a franchise to the Lima, Delphos, VanWert & Fort Wayne Traction Company, enabling it to reach the center of the city without operating over the tracks of the Lima Electric Railway & Light Company, as had been planned originally.

CLEVELAND, OHIO.—It is reported that owing to an alleged hitch between Senator Hanna and officials of the Cleveland Electric Railway Company regarding the division of stock, the proposed consolidation of the Cleveland systems has been declared off indefinitely.

COLUMBUS, OHIO.—The Columbus Railway Company has awarded a contract for an 1800-hp. engine and generator, and for a large traveling crane. A new steel roof is to be placed on the power house, and the cost of the contemplated improvements will be about $100,000.

NEW PHILADELPHIA, OHIO.—J. C. Welty, representing Tucker, Anthony & Company, Boston, who are building the line from Massillon to New Philadelphia, has deposited $1,000 cash and $5,000 bond with the county commissioners to insure the completion of the line by November.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate announces that it has secured the entire right of way for the proposed line from Wellington to Mansfield, which will be known as the Cleveland, Ashland & Mansfield Railway. The link will complete a through line from Bucyrus to Cleveland.

NORWALK, OHIO.—The Norwalk, Ashland & Southern Railway Company and the Mansfield, Greenwich & Norwalk Railway Company have both applied to the county commissioners for a franchise to build on the Wooster pike; the former to New London, and the latter to Jennings Corners and thence to Greenwich.

CLEVELAND, OHIO.—W. M. Bicknell, formerly of Cleveland, has been made general manager of the Aurora, Elgin & Chicago Traction Company. E. R. Gilbert, general manager of the Chicago Electric Traction Company, will succeed W. M. Bicknell as general manager of the Miami & Erie Canal Transportation Company.

CLEVELAND, OHIO.—The Western Ohio Railway Company has recently placed contracts with the C. & G. Cooper Company and the Westinghouse Electric & Manufacturing Company for generating sets to increase the capacity of the St. Marys power station from 800-kw to 2,300-kw. Stirling boilers of sufficient size for the new plant are being installed. The power station will have a maximum capacity of 3,800-kw.

CLEVELAND, OHIO.—J. E. Latimer and J. W. Holcomb have closed the option secured some time ago on the Cleveland, Painesville & Ashtabula Railway. The purchasers announce that construction work will start at once, a contract for building the line having been placed with the Electric Construction Company of this city. The power house has already been started, but the equipment has not yet been purchased. A $75,000 steel bridge will be required to cross the Grand River at Painesville.

YOUNGSTOWN, OHIO.—The Havana & Jainanitas Railway Company of this place has been incorporated at Dover, Del., with $1,000,000 capital stock. W. H. Park, Harry G. Hamilton, Myron A. Morris, J. N. Thompson and others of Youngstown are interested in the project, which contemplates the building of an electric railway from Havana to Jainanitas, Cuba, a distance of nine miles. The interested parties are identified with the Penhale-Devitt syndicate. W. H. Park and J. D. Milligan have left for Cuba. The latter will be in charge of the construction of the road.

PETERBORO, ONT.—The electric street railway of Peterboro, which has not been operated for the past three years, has been sold to a Detroit syndicate.

WEST CHESTER, PA.—The West Chester street railway has been sold to the Tennis Traction Company of Philadelphia. The Tennis company will proceed to complete the line between here and Downington, and will extend it to Parkesburg this summer. The company will also construct a line from Lenape to Unionville and Kennett Square.

SPARTA, WIS.—Capitalists have obtained a franchise from the city council to construct an electric railway. They also propose to extend the line to Melrose. The road will be about 25 miles in length.

GUADALAJARA, MEXICO.—The Compania Industrial, of the city of Guadalajara, which owns the electrical power obtained from the great waterfalls of Juanacatlan, near that city, is about to commence the construction of a new system of tramways in Guadalajara. The lines will traverse several of the principal streets of Guadalajara and will touch at several of the principal manufacturing establishments located in the suburbs. The old street railway system in Guadalajara is still operated by mules. The net receipts of this company, however, for the year 1901 were $75,000. It covers 44 kilometers of streets.

THE AUTOMOBILE.

THE EADS BRIDGE AUTOMOBILES at St. Louis, Mo., are now daily averaging about 3,000 passengers. Eighteen electric vehicles are in operation and two steam propelled machines will be tried as an experiment shortly.

AUTOMOBILES IN CHICAGO PARKS.—The South Park Commissioners of Chicago have passed a rule forbidding the use of the South parks and boulevards to automobiles leaving a trail of vapor or offensive odors or making excessive noise. There is some uncertainty as to just where the line will be drawn, but the action was directed chiefly at racing machines. Electric vehicles are safely out from under both the letter and the spirit of the rule.

NEW INDUSTRIAL COMPANIES.

THE SMITH STORAGE BATTERY COMPANY, Binghamton, N. Y., has been incorporated, with a capital of $100,000. Directors—T. J. Coster, M. O. Smith and A. C. Rahe, Binghamton.

THE AMERICAN LIGHT AND FIXTURE CO., St. Louis, Mo., has been incorporated with a capital stock of $4,000, all paid. The incorporators are W. J. Hughes, W. T. Thorn, Orlando Hinz and others.

THE METROPOLITAN SWITCHBOARD COMPANY has been incorporated in New Jersey; capital, $25,000. Incorporators—Thomas J. Murphy, George A. Annable, William C. Jones and John S. Adams.

THE POWELL ENGINEER'S SUPPLY CO. with a capital stock of $5,000, has been incorporated at St. Louis, Mo. Among the shareholders are John H. Workman, Charles H. Tentenberg, Edwin E. Francis, Wright N. Powell and H. Price Simsons.

THE DAVIES-SHERMAN MACHINERY & ELECTRIC COMPANY has been organized at Tacoma, Wash., with a capital of $5,000, to do general construction work and manufacture fixtures, switches, etc. This company is a reorganization of the M. C. Davies Machinery and Electric Company. Mr. Marcus C. Davies is president.

OBITUARY.

THE LATE C. E. STUMP.

MR. C. E. STUMP.—It is with deep pain and regret that we record the death from liver complaint, after a short illness at his residence in Flushing, L. I., of Mr. Clarence E. Stump, at the early age of 45. The deceased was born in Cincinnati in January, 1857, and began his journalistic career with the *Daily Herald* of that city. He put in a year at civil engineering but resumed journalism, and on arriving in New York became one of the founders of the *Daily Hotel Reporter*, of which he was editor and manager for five years. Early in 1883 he became associated with the old *Operator and Electrical World* and continued as business manager of the *Electrical World* until 1891, seeing the journal grow in size and importance and doing very much by his personal influence to make it a power in the electrical field. He had many brilliant opportunities of advancement in the industry itself, but preferred to stand by the paper he had helped to create. He was now offered the vice presidency of the company issuing the *Street Railway Journal*, and having had a warm interest with numerous friendships in that rapidly growing branch of the art, he decided to make a change. In 1893 he considered that the time was ripe for a weekly street railway paper, and essayed the publication of the *Street Railway Gazette* in Chicago. He struck the distress of the hard times, however, and removed the offices to New York in 1894. A little later the paper was bought and absorbed by the *Electrical World*. Early in 1896 Mr. Stump became publisher of *City Government*, now the *Municipal Engineer*, and with this he continued until 1899. An old friend, Mr. Louis Klopsch, of the *Christian Herald*, had been urging him for some time to take charge of his vast publishing department in New York City, and as this gave Mr. Stump an opportunity to indulge his always strong mechanical tastes as well as exercise his great executive ability as a publisher, he consented, selling out his interests in all other publications. In this employ he remained up to the time of his death. Mr. Stump took an active and prominent part in the development of many early electrical institutions and enterprises, giving his time and money and influence freely in aid of friends and to worthy causes. He was also a Mason and rose to the highest degrees and honors in the craft. His position threw him into personal relationships with the leaders in electrical science and art, and on both sides of the Atlantic are many of the foremost men who held him in high esteem and regard. He was also a life-member of the International Association of Municipal Electricians and took a leading part in its organization. Of affable manners, too easy natured for his own best interests or those of others at all times, a hard worker, and unexcelled in his own lines of endeavor, Mr. Stump made an enviable record, and won a host of admirers who will always cherish his memory with tenderness and affection. Masonic funeral services were conducted on Sunday afternoon, Mr. F. H. Scherer, Past Grand Master of the State of New York officiating, Anglo-Saxon Lodge, of which Mr. Stump was a past-master, attending in a body. The interment took place at Cypress Hills Cemetery, Brooklyn, on Monday morning. The deceased leaves a widow, but no children.

MR. MAX DIETRICH, former secretary of the Empire Carbon Works, St. Louis, Mo., died on April 2 at the residence in that city of his son-in-law, George Beck, president of the Empire Company. He was secretary of the company until two years ago, when he resigned on account of ill health. The cause of Mr. Dietrich's death was pneumonia.

PERSONAL.

PROF. ARVID REUTERDAHL, of Providence, R. I., made a visit to New York last week.

DR. LOUIS DUNCAN has been appointed head of the department of Electrical Engineering at the Massachusetts Institute of Technology.

MR. C. A. SPOFFORD, well known in electrical circles has, it is said, gone to London to join the staff of Mr. Yerkes in the management of the underground electric railway properties.

MR. W. E. SIMPSON, president of the Goshen & Indiana Traction Co., has left for Europe in furtherance of plans for the early construction of an interurban railway from Goshen to Angola.

GEN. E. B. FOWLER.—A bronze statue has been unveiled in Brooklyn, Fort Greene, of Gen. E. B. Fowler, the war commander of the Fourteenth Regiment, who was afterwards prominent in the management of the Commercial Cable up to the time of his death.

MR. C. S. POWELL, Cleveland district representative for the Westinghouse Electric & Manufacturing Company, will leave New York about June 4 for a two months' pleasure trip to Europe. He will devote considerable time to studying the power plants in the cities he visits.

MR. EDWARD E. GOUDEY, formerly foreign manager for the Wagner Electric Company, and now Secretary of the Goudey-McLean Company, New York, who has been abroad since last October in the interest of his company, will return by the Atlantic transport liner "Minnehaha," due to arrive in New York, June 7.

MR. HORACE E. ANDREWS, president of the Cleveland Electric Railway Company, gave a luncheon a few days ago to the retiring general manager of the company, Ira A. McCormack, at the Euclid Club, Cleveland, Ohio, and had as guests a number of prominent visiting steam railway men. Mr. McCormack goes to New York to become division superintendent of the New York Central.

MR. CHARLES H. ERWIN has been appointed superintendent of the Western Union Telegraph Company, with headquarters at New York, in place of Mr. Walter C. Humstone, who recently resigned. Mr. Erwin was Mr. Humstone's assistant, and is therefore, through his familiarity with all the details, thoroughly qualified to fill the new position. His territory embraces New York City, including 250 branch offices, and 1,500 offices in the States of New York, Pennsylvania, New Jersey, Massachusetts, Connecticut and Vermont.

Trade Notes.

REMOVAL.—The Metropolitan Telephone & Electric Company has moved to 610 Wilson Ave., Chicago.

THE ELECTRIC FURNACE COMPANY has removed its offices from 52 William St. to 180 Broadway, New York.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that an appreciative public is not letting it forget that it is headquarters for Packard incandescent lamps. The orders for last month have broken the record.

THE REUTERDAHL ELECTRIC CO., Providence, R. I., has opened a New York office at 72 Trinity Place, in charge of Mr. Horace M. Williams. Mr. Williams has had an extensive experience in and around New York City in representing other lines of trade and is thoroughly acquainted. The Reuterdahl cell, it is stated, has given much satisfaction to its users.

MR. RAY D. LILLIBRIDGE, the well-known trade press and advertising expert, who represents Stanley, Link Belt, Otis Elevator, and other interests, has now had confided to his skill for securing profitable publicity the press business of the famous Cazanove, "Vin Monarque" champagne, one of the best-known French wines. The '93 brut brand will be pushed in this country.

COMMUTATOR BARS.—The Sterion Copper, Brass & Bronze Co., of 65 and 67 N. Ashland avenue, Chicago, is putting on the market a line of copper commutator bars from less than a half ounce each up to 16 ounces each and over. These bars are made to specific order or can be had in the standard shapes and sizes. The Company also makes switch blades, splicing sleeves and other electric copper details.

REFRIGERATION AND COLD STORAGE.—The H. W. Johns-Manville Company, New York, has issued a pamphlet on refrigerating and cold storage by the use of Keystone hair insulator. This insulator, it is stated, insures the maintenance of even temperatures with the lowest first cost for equipment, boilers, compressors, and piping. It possesses many advantages which are all pointed out in the pamphlet.

NEW YORK TELEPHONE CO. has distributed an extremely handsome and striking pamphlet on telephone service in New York city, with special reference to hotels and apartment houses. The cover and decorations are what we esume should be styled "impressionistic" and "art nouveau," in grays and greens, mauves and sombre tints, while the illustrations are excellent and the text admirable, pertinent and persuasive. The company is doing a large business in this field now and expects a very rapid increase.

FIRE-DETECTING WIRE.—The wide scope of the uses of Montauk fire-detecting wire and its various advantages are pointed out in a booklet just issued by the Montauk Fire-Detecting Wire Company, of New York. The system is briefly described and an understanding of its operation is materially advanced by the aid of diagrams. The advantages and importance of this system are obvious to those who have investigated it, and it is assuring to know that the system has been approved by the New York Board of Fire Underwriters.

C. K. HILL, Pittsburg, Pa., has recently moved into his new building, corner Liberty Ave. and Seventh St. The new quarters are most attractive in appearance, conveniently arranged and offer every facility for promptly satisfying the demands of the most exacting customer. The first floor is occupied by the principal salesroom, in the rear of which is the packing room. On the second floor are the offices and a spacious showroom. The third floor is given over to manufacturing. In the basement is a complete lighting plant, as well as facilities for storing heavy goods and reserve stock.

THE DOUBLEDAY-HILL ELECTRIC CO. Pittsburg, Pa., has recently installed a uniform filing system throughout the different departments of its business. As a result it is in better shape than ever to fill orders promptly and accurately. Invoices are invariably sent on the same day on which the goods are shipped. The company reports excellent prospects for a record breaking fan business this year. It is well prepared to meet this demand, having recently received four carloads of Emerson fans and two carloads of fans of other makes. The repairing and winding department which this company established several months ago is meeting with success beyond all expectations. This rapid growth has necessitated additional machinery recently and the employment of additional skilled workmen.

THE WESTERN ELECTRICAL SUPPLY CO., of St. Louis, has just issued one of the most complete telephone catalogues that has ever been produced. It is a volume of very nearly 200 pages, handsomely bound, and devoted exclusively to telephone apparatus and telephone line and construction material. There is nothing pertaining to the operation, maintenance or equipment of telephones lines and exchanges, which is not shown in this catalogue. It illustrates a large number of new and up-to-date devices which have never been in a catalogue before. This is the first catalogue, it is said, which has ever been issued which covers the complete requirements of a telephone line and exchange. It should certainly be a very valuable book to any one interested in telephone line and construction material. This company claims that it is now carrying probably the largest stock of telephone line and construction material in the United States, and states that it is prepared to furnish promptly from St. Louis stock anything illustrated in this catalogue. A copy of the catalogue will be mailed on application.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 13, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

699,640. TROLLEY HEAD OR WHEEL; G. Aye, Kittanning, Pa. App. filed Sept. 28, 1901. The wire runs through a triangular space formed by the rims of three wheels and is thereby confined to the trolley; ice-scrapers are also a feature.

699,643. CONTROLLING ATTACHMENT FOR TROLLEY POLES; R. J. Barry, Westboro, Canada. App. filed Dec. 10, 1901. The pole is prevented from rising beyond the wire by a link attached to the roof of the car by a spring which opposes the spring on the trolley arm.

699,647. SAFETY FUSE FOR ELECTRIC CIRCUITS; D. G. Black, Brooklyn, N. Y. App. filed Jan. 3, 1902. Two wire-terminals under spring tension are connected together by a small globule of fusible metal.

699,651. ELECTRIC HEATER; M. C. Burt, Chicago, Ill. App. filed Oct. 30, 1901. The heating resistance is wound around a pipe whose walls are perforated and air is forced through the pipe to create a circulation through the resistances.

699,654. ELECTRIC FURNACE; G. De Chalmot, Holcombs Rock, Va. App. filed July 8, 1898. (See page 910.)

699,658. STORAGE BATTERY; H. J. Cogswell, Hartford, Conn. App. filed Oct. 26, 1899. A pencil or core of lead is formed along its length with abutments between which are disposed at short intervals a series of annular flanges between which the active material is located.

699,660. POLARIZED ELECTROMAGNET APPARATUS; F. B. Cook, Chicago, Ill. App. filed Aug. 29, 1899. (See page 912.)

699,676. TELEPHONE CIRCUIT; G. E. Goodhead, Winchester, Ill. App. filed June 14, 1900. (See page 912.)

699,677. MEDICAL BATTERY; F. Greer, Chicago, Ill. App. filed Sept. 27, 1899. Details.

699,713. PLASTIC COMPOUND AND THE METHOD OF MANUFACTURING SAME; L. M. Randolph, Newark, N. J. App. filed Sept. 5, 1901. An insulating compound consisting of varnish residue, peat and oakum.

699,714. HEADLIGHT FOR MOTOR CARS; C. Reinker, Cleveland, O. App. filed Feb. 11, 1901. The lamp feeds when the circuit is broken and completed momentarily and for this purpose the trolley conductor is covered with insulation at intervals to interrupt the current to the lamp.

699,734. ELECTRIC GENERATOR; J. M. Wilson, Battle Creek, Mich. App. filed Apr. 27, 1901. A dynamo adapted to be attached to a bicycle and driven thereby for supplying the bicycle lamp.

699,744. TROLLEY WHEEL; G. E. Chapman, G. L. Ensign and J. M. Weir, Cleveland, O. App. filed July 16, 1901. The contact device between the wheel and the harp has both tangential and lateral connection with the wheel.

699,761. INSULATOR; H. F. Kretzer, St. Louis, Mo. App. filed Jan. 27, 1902. A knob having a seat for a lightning rod and suitable grooves for a binding wire.

699,764. SYSTEM OF ARMATURE WINDING FOR ELECTRIC MOTORS; T. J. Murphy, Montreal, Canada. App. filed Oct. 17, 1901. Details.

699,787. ELECTRIC RAILWAY SYSTEM; G. L. Campbell, Nyack, N. Y. App. filed Aug. 23, 1901. A system in which a trolley in a closed conduit is moved along by the attraction of a magnet carried by the car and this invention provides for the insertion of non-magnetic plates and walls at crossings to prevent interference with the action of the trolley.

699,841. ELECTRIC SIGNAL DEVICE; T. J. Hoover, Carlinville, Ill. App. filed Sept. 20, 1901. An automatic switch is arranged to close the circuit containing a semaphore whenever a draw-bridge is open or a portion of the track destroyed.

699,851. APPARATUS FOR FUSED BATH ELECTROLYSIS; C. W. Roepper and G. P. Scholl, Philadelphia, Pa. App. filed Aug. 29, 1898, renewed Oct. 15, 1901. (See page 910.)

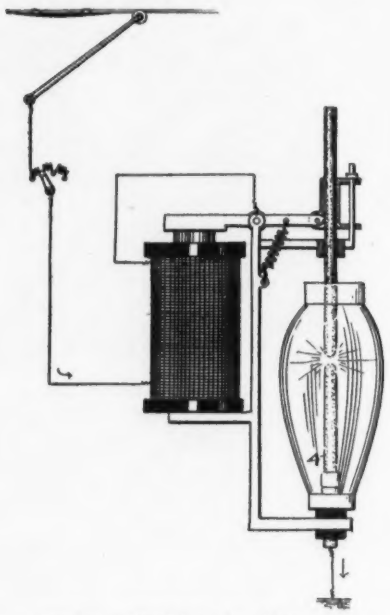
699,863. DEMAGNETIZER; G. Boettger, Milwaukee, Wis. App. filed March 24, 1902. A switch for rapidly reversing the magnetism of a solenoid consisting of two plates having alternating teeth in line with each other, over which the circuit terminals travel.

699,899. ELECTRIC METER; G. A. Scheeffer, Peoria, Ill. App. filed Jan. 10, 1900. An oscillating meter having means for effecting a reverse movement of the oscillating element when it has been rotated by the normal torque of the meter to a predetermined point in its oscillation, the means for effecting the reverse movement of the oscillating member counteracting the torque.

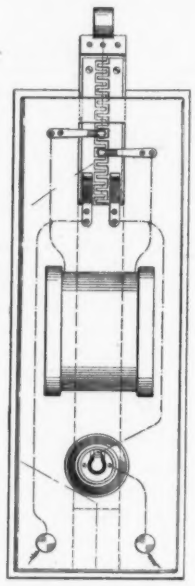
699,902. RAIL BOND CONSTRUCTION; E. G. Thomas, Cambridge, Mass. App. filed Nov. 1, 1901. A rail bond consisting of a flexible strip bent laterally between its ends and thereby adapted to be passed through an opening in one or both of the rails to be joined, and to be attached at each end to one of the rails.

699,907. ELECTROLYTIC APPARATUS FOR MANUFACTURING CERTAIN SALTS SUITABLE FOR THE SUBSEQUENT PRODUCTION OF CHLORINE; G. J. Atkins, London, Eng. App. filed Aug. 17, 1901. (See page 910.)

699,914. CEILING BLOCK; C. W. Dixon, Pittsburg, Pa. App. filed Aug. 19, 1901. Details.



699,714.—Headlight for Motor Cars.



699,863.—Demagnetizer.

699,927. TROLLEY; P. McCullough, Tuebrook, Liverpool, Eng. App. filed June 24, 1901. An arrangement which enables the trolley head to separate from the pole without injury to the conducting wire when an exceptional pull is applied, such as is the case when the head gets entangled.

699,951. ELECTRIC CONTROLLER; J. C. Henry, Denver, Colo. App. filed April 1, 1901. The method of operating a pair of electric motors, which consists in connecting the armatures in series relation and the fields in shunt relation thereto; changing the combined machine to parallel and then speeding up by placing the fields of both motors in series.

699,952. CIRCUIT CONTROLLER; R. Herman, Crafton, Pa. App. filed Oct. 7, 1901. Details.

699,964. ELECTROLYTIC CONVERTER; F. H. Long, Chicago, Ill. App. filed Oct. 18, 1900. (See page 910.)

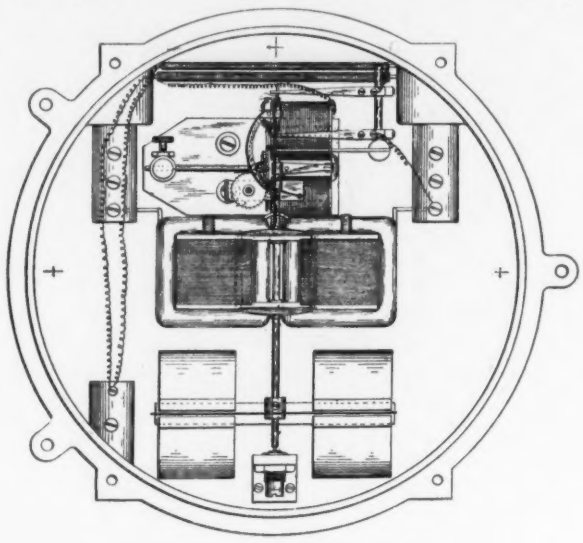
700,019. COLLECTION RECORDING MECHANISM; G. F. De Groot and I. L. Thompson, Morristown, N. J. App. filed Aug 8, 1901. A system wherein the collections of mail from the letter boxes by the carriers is recorded at the central post office.

700,027. BURGLAR ALARM FOR SAFES; I. J. Emory, Waverly, O. App. filed Dec. 16, 1901. An inclosed space in front of a safe, has a movable floor by which an alarm circuit is closed by the weight of a person on the floor.

700,037. REPEATER FOR TELEGRAPH LINES; J. W. Gray, Fowler, Ind. App. filed Nov. 22, 1901. Details.

700,052. ELECTRIC MOTOR CAR OR LOCOMOTIVE; C. DeKando, Budapest, Austria-Hungary. App. filed April 13, 1901. To make high-tension currents safe for use on tram cars, all of the conductors and parts which carry current, are encased in metal tubes which are grounded.

700,079. POTENTIAL REGULATOR; R. A. Philip, Seattle, Wash. App. filed Nov. 5, 1901. This invention is for the purpose of modifying the voltage returned to the station by a group of pilot wires in such a way that, instead of representing the potential at some particular point, the voltage indicated is proportionate to the average potential at a number of points of the system; this reduces the liability of the general potential of the system being injuriously affected by local disturbances.



699,899.—Electric Meter.

700,107. MANUFACTURE OF ELECTRIC CABLES; J. H. West, Berlin, Germany. App. filed Sept. 21, 1901. To obtain the lowest static capacity in the cables, they are strung upon a helix of insulating material such as paper, being seated in notches in the helix and thereby separated by air spaces.

700,111. ELECTRICAL MEASURING INSTRUMENT; V. Arcioni, Spoleta, Italy. App. filed July 25, 1901. A counter-balancing device for equalizing the action of the current on the movable part of the instrument.

700,126. SYSTEM OF ELECTRIC RAILWAYS OF THE SECTIONAL TYPE OF CONDUCTORS OR RAILS; C. J. Kintner, New York, N. Y. App. filed Dec. 2, 1901. Utilizing a part of the working current taken from a live section over which a car is passing, to prevent any circuit connection between a sectional conductor immediately in the rear of the live section and the current feeder, until the car has passed out of the section on which it is located.

700,127. ELECTRIC RAILWAY; C. J. Kintner, New York, N. Y. App. filed May 6, 1901. This invention contemplates lowering the current flow through the terminals of a switch at the time that the corresponding sectional conductor is disconnected from the current feeder, to such an extent as to avoid injurious arcing.

700,128. ELECTRIC RAILWAY; C. J. Kintner, New York, N. Y. App. filed May 6, 1901. A safety system in which cars are automatically prevented from approaching each other to a certain distance and in which draw-bridges are prevented from opening after a car has approached within a certain distance of it.

700,129. ELECTRIC RAILWAY; C. J. Kintner, New York, N. Y. App. filed May 6, 1901. Signals are arranged to be operated coincidently with the energizing and de-energizing of the sections of a third rail, to thereby indicate to motormen the position of cars with respect to the sections.

700,130. ELECTRIC RAILWAY; C. J. Kintner, New York, N. Y. App. filed Dec. 5, 1900. A safety system wherein the current to the sections immediately ahead and behind a car is controlled and co-operating signals likewise operated. The invention also relates to the manual control of current to the sections.

700,134. TROLLEY; M. P. Crehan, Pittsburg, Pa. App. filed Oct. 25, 1901. The trolley wheel is spring-mounted at the end of the pole.

700,136. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed March 5, 1901. (See page 910.)

700,137. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed March 5, 1901. (See page 910.)

700,160. DENTAL MALLET; J. W. Thatcher, San Francisco, Cal. App. filed Jan. 25, 1902. A reciprocating drill which is set in motion by pressure of the drill point against the filling of the tooth.

700,161. TELEPHONIC RECEIVER FOR WIRELESS SIGNAL APPARATUS; T. Tommasina, Geneva, Switzerland. App. filed May 24, 1900. (See Current News and Notes.)

Supplement to ELECTRICAL WORLD AND ENGINEER, *May 24, 1902.*

Twenty-fifth Convention of the National Electric Light Association.

THE twenty-fifth convention of the National Electric Light Association was called to order at the Grand Hotel, Cincinnati, 10:20 A. M., May 20, 1902, by President H. L. Doherty. Gen. A. Hickenlooper, president of the Cincinnati Gas and Electric Company, welcomed the convention to Cincinnati in the name of the city's chief executive, who was absent from the city. He spoke of Cincinnati's importance as a manufacturing center. Out of half a million people, 200,000 are engaged directly in manufacturing. In referring to the large factories, the growing importance of the Bullock Electrical Manufacturing Company in the electrical field was enlarged on with no little eloquence and local pride, and in concluding, the wish was expressed for a most profitable convention.

Past Pres. Fred Nicholls, of Toronto, Canada, responded to the address of welcome in behalf of the Association. He said that the association had never assembled in any city where so great and varied entertainment was promised. He extended a cordial vote of thanks in the name of the body.

President Doherty then made a few preliminary announcements. Owing to the length of the programme, he urged the necessity of meeting on time. He also urged a general response to questions in the question box. Fully 80 per cent. of the members he considered capable of giving advice on some special topics, and their contributions were especially needed for answering question-box inquiries. He then delivered the president's address, and inaugural utterances of this kind have rarely been given that contained more in the way of profitable suggestion, both for the industry and the association.

PRESIDENTIAL ADDRESS.

President Doherty called attention to the healthy financial condition of the Association, and pointed out how its method of preparing a programme had been varied by eliminating long papers on technical subjects in favor of short written practical discussions and of replies to "Question Box" inquiries and topics. He recommended that the Association elect not only a president each year, but an editor to report progress made in methods and apparatus, with as many sub-reporters as the work might demand. He also directed attention to some of the topics to be treated, and noted as to steam turbines that a manufacturer recently gave a bid on one for direct connection to an alternator with a steam guarantee about equal to 10 pounds per indicated horse-power below the reciprocating engines they now had. The province of the Association he defined as the study of such matters, to assist central station managers, and he placed its sphere midway between that of the American Institute of Electrical Engineers and those of the smaller local Associations, the managers in which could not afford participation in the work of the national body. He believed in affiliating with and building up these smaller organizations, just as on the other hand he advocated co-operation with the Institute, particularly in such matters as the adoption of the metric system, which he discussed very favorably.

With regard to relations with the manufacturers, Mr. Doherty made some strong remarks, but said that on the whole "we want the assistance of all of the manufacturing companies, and we can reap considerable benefit from their co-operation. In the long run, and on some points especially, our interests are absolutely identical and yet some manufacturers, by a short-sighted business policy, aim to gain small profit for themselves at great expense to the central station industry and the retardation of central station development by cultivating competitive conditions."

As to municipal ownership, Mr. Doherty remarked very shrewdly that the efforts of its advocates were productive of the very thing they most wished to avoid, namely, the formation of large syndicates for the control of the private properties, which were able thus to protect themselves against raids of all kinds. He advocated work by the Association and by individual members against the movement, and recalled the effort made to bring the League of American Municipalities to time in making an investigation of a number of municipal plants. If this could not be forced, possibly the American Economic Society, whose members came largely from academic professors and had a sincere but unpractical view of the subject, might be induced to join with them in such an investigation. The fact remained that 90 per cent. of the municipal plants were rank failures, and it only remained to demonstrate the true conditions.

As to the development of the electric lighting business, Mr. Doherty made some striking and pertinent remarks, saying:

We have not yet reached the commercial age, and I predict that within five years our Association will almost lose sight of engineering matters in their eagerness to increase their sales. Our earnings through economy of operation have well defined limits, but the possibilities of increasing our earnings by developing our market have a much wider range. About 70 per cent. of all of our expenses are not influenced by the output of our station, and are only partially influenced by the capacity of our station. We sell only from 10 per cent. to 30 per cent. of the amount of current we are capable of generating, and our plants therefore lie practically idle about 70 per cent. to 90 per cent. of the time. It is not possible to acquire a daily uniform load, but we can greatly influence the load factor of our stations by the class of business that we encourage. We want that class of business which demands the least investment, and which yields the greatest consumption. I think we must lessen the difference between our operating costs and selling price.

It is possible to make the greatest returns to the capital invested when the income per kw is nearly at a minimum. I believe our business today might be considered as of a retail nature compared with what it will be a few years hence. I see no reason why central station companies should not furnish every bit of power used in any town regardless of size of installation. One power house can be run more economically and with less aggregate capacity than several, and we must content ourselves with a smaller margin of profit per kw, our future profit being represented by a greater degree of economy resulting from a central station operation versus isolated station operation. One central station with which I am acquainted supplies eleven-fourteenths of all the power used in the town in which it is situated. The officers of that company are laboring with the other three-fourteenths, with strong prospects of acquiring the greater portion of it. Another central station with which I am acquainted did not make any appreciable gain in output for ten years, although they had a large increase in connected load and a slight increase in earnings. The whole condition resulted from the rates of charging in vogue. Their rates were so high, and so inequitable to users of light for long hours, that each year they were losing a portion of their connected capacity by the installation of isolated plants; but the natural growth of their town and business was giving them an increase in connected capacity of nearly three times that lost by isolated lighting, although from the standpoint of consumption their three new connected lamps did no more than compensate for the one lamp lost by isolated lighting. The investment for this station had gradually crept up until it represented an investment of $16 per lamp connected. Their connected load was 630 lamps, or their equivalent, per 1,000 inhabitants. During the past year they have inaugurated a different policy, and their connected load has been materially increased without a corresponding increase in capital investment, and their investment now represents $12 per lamp wired up, and they have 917 lamps per 1,000 inhabitants. I predict that they will have in another year 1,500 lamps wired up per 1,000 inhabitants, which will represent an investment charge of $8 per lamp wired up. Previously they were compelled to make $1.60 per lamp profit, over and above operating expenses, in order to take care of interest and depreciation. Now if they brought their investment down to $8 per lamp wired up, they would only be required to make 80 cents above operating expenses to cover interest and depreciation.

Line, meter and transformer efficiency have often been so low in alternating-current stations that the stations were paid for but

from 35 per cent. to 65 per cent. of the current sent out, and even then the cost of lost current in alternating stations was not as great as the additional interest charge in direct-current stations. Core loss in transformers and interest can be considered as charges of an identical nature. Assume that you are using individual transformers for each house, and are installing transformers' capacity equal to 100 per cent. of your connected load. We will assume that, with a transformer installation of this magnitude, your iron loss is 2 per cent. of its rated capacity. Now 2 per cent. does not look high, but it must not be forgotten that your 2 per cent. is 2 per cent. loss of current at full load, and 100 per cent. loss of current at no load. With a 2 per cent. transformer loss, your aggregate loss is approximately 10 kw per lamp per year. Your average sales per lamp per year in the average Western station, covering both the residence and business districts, will be in the neighborhood of 18 to 20 kw. This average will represent lamps using from less than 1 kw per lamp per year to 400 kw per lamp per year. With an installation which averages one kilowatt per lamp per year, you must send from the station ten kilowatts for loss in the transformer and one kilowatt to be sold. If you are selling current at 20 cents per kilowatt-hour, you are getting for the one kilowatt sold 20 cents, but for the 11 kw sent from the station you are getting but 1 8-10 cents per kilowatt-hour. As you increase your sales per lamp per year, assuming that your selling price remains constant, your income per kilowatt generated increases very rapidly.

It is simply absurd to ever expect to properly develop business as long as charges are made only on the basis of current consumed, and what I have stated about the transformer loss is true also of the investment expenses, which would be encountered if a direct-current station were used. If we must spend a dollar for interest, or spend a dollar for current to be lost in a transformer, we are no better off in one case than in the other. Personally, I believe I would prefer to spend a dollar for core loss in transformers, as we have better opportunities of reducing this expense than an interest expense. If every small consumer was made to pay all of the costs which he occasions, we could sell current at a much lower rate. At a much lower rate we can considerably increase our sales, and can probably keep up the development of our market by reductions in the selling price without impairing the percentage return on the money invested. As we reduce the price of current we may expect a lavish use of it for sign and decorative lighting. We may also expect a great acceleration in the standard of illumination, which is already constantly increasing.

Mr. Doherty then remarked that the question of forcing distributing lines under ground is being agitated all over the country, and that they were largely responsible for the dislike the public has for pole lines. It is possible to have overhead work which is neat and unobtrusive, and yet almost every central station in the country has unsightly, unpainted poles, with an irregular network of badly strung conductors, representing three or four times the number of wires needed for conduction of current. In the event of a feeder wire becoming too small, it has become the custom to string other feeders in parallel. He urged the use only of long, straight cedar poles, painted a color to harmonize with their surroundings, but said they must pay more attention to underground work. With the consent of the executive committee, he would offer a gold medal, suitably inscribed, for the best paper on underground construction.

In closing, Mr. Doherty returned to the work of the association, and suggested that it have a Wrinkle Department, an Advertising Department, a Department of Decorative Lighting, a Department of Sign Lighting and a Department of Office Methods and Accounting, with committees on Steam Results, Thefts of Current, Methods of Collection, etc. In conclusion, he remarked:

I think we should extend an invitation each year to the professors of electrical engineering in all the colleges throughout the country, and address a letter to the faculties of the universities, calling their attention to the fact that by having the professors of electrical engineering attend our conventions they can keep in closer touch with central station work, and be able to more intelligently conduct the course of studies for those students who expect to take up central station work. Each year I have occasion to employ a number of young college graduates. They come to me sadly lacking in certain respects, particularly in their lack of knowledge of the laws of heat and thermodynamics, or else they are unable to apply whatever they know regarding this subject. They also seem to be incapable of thinking of expenses as anything but operating expenses, without regard to fixed expenses, such as interest, taxes, etc., and even if they do take these fixed expenses into their calculations, they do not seem to comprehend how large an item of expense they may be if a plant can only be operated for a small portion of the time, while these expenses go on constantly, 24 hours per day and 365 days in the year. It would also be greatly desirable if they could have some knowledge of accounting, but I do not know that it is practicable to give them a proper insight into this branch of our business during their college course.

At the close of this address of President Doherty, which was listened to with much interest and applauded vigorously, Mr. Nichols, of Toronto, moved that the secretary appoint a committee to consider means of best carrying out the numerous important suggestions made by Mr. Doherty, as he considered that after so many good ideas had been put forward, something should be done towards carrying them out. The secretary appointed Mr. Perkins, of Youngstown, O.; Mr. R. S. Kelsch, of Montreal, and Mr. C. E. Hewitt, of Elkhart, Ind.

The president then announced that the association would go into executive session for the remainder of the morning, as there were matters of vital importance to consider.

At the executive session, Tuesday morning, retiring Secretary Porter was given a vote of thanks, and Lieut. James Blake Cahoon was formally appointed secretary.

Tuesday afternoon at 2:20, when the meeting was called to order, L. A. Ferguson named a committee on revision of the constitution and by-laws, according to action taken at executive session in the morning. The committee named was: C. L. Edgar, of Boston; Fred. Nicholls, of Toronto, and C. E. Hay, of Springfield, Ill.

The president announced that a visit to the Bullock Electric Manufacturing Company's works would be made Wednesday afternoon, leaving the hotel at 4 P. M.

W. E. Moore, of Augusta, Ga., then read his paper on the subject, "Does it Pay to Creosote Wooden Poles for Electric Line Work?"

A number of questions were asked Mr. Moore regarding the process which his company is using. Dr. F. A. C. Perrine spoke of the methods of treating railroad ties, as described in U. S. agricultural reports and practiced on the Southern Pacific Railroad, as being somewhat different from that described by Mr. Moore. Some of the operations Mr. Moore described had been found detrimental. A temperature of 300 degrees or over was too high. The rapid drawing out of sap made explosions, which checked the wood. In answer to inquiry as to the government publications on the subject, a member said that "Metal Railroad Ties," issued by the department of agriculture and some other publications given in the bulletin of publications of that department were worthy of recommendation. Pres. Doherty said that a lime water bath neutralized the acid on creosote treated poles so that they could be handled with more comfort.

Then followed a lengthy discussion on "What Efficiency Lamp Should Be Used, and How May this Efficiency Be Determined for any Particular Station?" Written discussions were submitted by Messrs. H. L. Doherty, S. E. Doane, L. G. Van Ness, F. W. Willcox, and Converse D. Marsh.

Following this was a lengthy and somewhat animated discussion over President Doherty's position that for most central stations a 16-cp lamp taking 4 watts per cp is more economical to the central station and consumer than a 3.1 watt lamp; it being assumed that the central station furnishes free renewals, and that the price of current per kw-hour to the consumer be reduced so as to make the price to him the same per cp-hour as with a high efficiency lamp. Mr. Doherty maintained that the cost of lamp renewals for the higher efficiency lamp more than compensated for the additional cost of energy for the low efficiency. Other members did not by any means agree with this, but it finally simmered down to the question of how much the additional electrical energy would cost in each particular plant, and hence became a problem for each member to figure on for himself. The discussion was useful, as it set members thinking seriously along this line of better service.

The vigorous and business like policy of President Doherty in conducting affairs of the association was shown by the holding of sessions not only all day but evenings as well. Owing to the heat, it was pretty severe, however, on the delegates. Tuesday evening the session was opened by the paper of Irvin Butterworth on "What is the Best Method of Caring for Consumers' Complaints." This was followed by a short discussion.

J. P. Crowley then presented his discussion on "What Changes

Should be Made in the Plan of Uniform Accounting," submitted at last convention. "Loose Leaf Ledgers" were then taken up in four brief written discussions submitted by G. E. Tripp, H. H. Fairbanks, Geo. W. Davenport, and Charles R. Price. Answers to questions in the question box took up the remainder of the term until 10:45 p. m., when the convention adjourned.

WEDNESDAY'S SESSIONS.

Wednesday morning at 10:15 the session was opened with the discussions of B. A. Behrend and C. F. Scott, on "Three-Phase *vs.* Two-Phase for City Distribution." Although this was intended for a debate, the two gentlemen substantially agreed that in the main for large plants three-phase, four-wire distribution was most desirable, while for small plants in some cases two-phase distribution might be best.

The president announced as committee on memorials, E. H. Davis, F. E. Smith and W. E. Moore. On nominations, the committee appointed was Jas. I. Ayer and H. H. Fairbanks. An addition to the committee on dues was made by the president, consisting of Messrs. Edgar, Hay and Nicholls.

The remainder of the morning was taken up with answers to questions filed in the "question box." In connection with one of these, Capt. Brophy, as chairman of the committee on wiring rules, called attention to the proposed rule of the underwriters canceling the insurance on any building which had within 75 feet of it an alternating-current circuit with more than 3,500 volts between wires. He said that his committee had opposed the rule, and had pointed out its inconsistency when 8,000 volt direct-current arc circuits are, and always have been, permitted. He also called attention to the great amount of money already invested in circuits of the kind, which the rule practically forbids. Mr. Abbott, of the Chicago Edison Company, showed that under such a rule the whole insurance in the city of Chicago could consistently be cancelled. His company had 3,800-volt circuits on over 50 miles of street, and these crossed other lines of various kinds covering the whole city and vicinity. A committee was appointed to draw up resolutions regarding the proposed rule.

Wednesday afternoon at 2:15 the answers to questions were taken up for a few moments, and then the Third Progress Report of the Committee for the Investigation of the Photometric Values of Arc Lamps was read.

Prof. W. E. Goldsborough then took the floor to extend to the association in the name of the directors of the Louisiana Purchase Exposition, an invitation to hold its 1904 convention on the exposition grounds at St. Louis. As director of electrical exhibits at that exposition, he also asked the co-operation of members of the association in making the Louisiana Purchase Exposition memorable, electrically. On motion of Mr. Jas. I. Ayer, it was unanimously voted to hold the 27th convention at St. Louis.

The subject of Protection of Long-Distance Transmission Lines was next taken up. Dr. F. A. C. Perrine first read a communication on the subject, followed by P. M. Lincoln. Communications on the same subject were read by title from Chas. H. Baker, L. Denis and Henry J. Gille.

In regard to the advisability of putting up barbed wire along a line for protection against static discharges and lightning, Mr. Lincoln said that on the Niagara Falls transmission line barbed wire had been taken down several years ago, because it had made more trouble than it had prevented, but that it was not unlikely that it would be put up again in more substantial shape. Dr. Perrine favored the use of barbed wire, but said it should be special quality and not ordinary cheap fence wire. He considered barbed better than bare wire.

The convention then adjourned at 4 P. M., to take a special train on the B. & O. to the Bullock Electric Manufacturing Company's works, at Norwood.

Wednesday evening the convention went into executive session and elected the following officers: F. A. Ferguson, of Chicago, president; C. L. Edgar, of Boston, first vice-president; E. H. Davis, of Williamsport, Pa., second vice-president; executive committee members, to serve three years, S. T. Dunham, of Hartford, Conn.; P. G. Gossler, of Montreal, Can.; H. D. Hartman, of Philadelphia, Pa.; executive committee members, to serve two years, J. H. Perkins, of Youngstown, O.; C. F. Hewitt, of Elkhart, Ind.; executive committee members, to serve one year, Arthur Williams, of New York; Lieut. Jas. Blake Cahoon, of New York, secretary and treasurer; Miss Harriett Billings, of New York, assistant secretary and treasurer.

A new scale of membership fees was also adopted, to take effect Jan. 1, 1903, as follows: Initiation fees for all companies, $25; annual dues for companies in towns of 20,000 or less population, $10 a year; for companies in towns of 20,000 to 300,000 population, $25 a year; for companies in towns of over 300,000 population, $50 a year.

The convention after transacting this business went into open session. Russell Spaulding read a paper on "Display Lighting, Signs and Decorations," and this was followed by the paper of E. J. McAllister, on "The Possibilities of Sign and Decorative Lighting." This closed the programme of the second day.

THURSDAY'S SESSION.

(*By Telegraph.*)

The session was opened by a discussion on the Nernst lamp, after which committee reports were considered. Mr. Frank A. Wolff, of the National Bureau of Standards, delivered an address outlining the policy of that bureau with respect to electrical standardization. After a discussion on rates and transmission lines, in which President Doherty and Dr. Perrine took leading parts, the session adjourned. At the afternoon session the subject of steam turbines was discussed, and Messrs. Ferguson, Wallis, Patterson, Scovil, Phillips and Dow continued the discussion on rates. Resolutions were adopted commending the administration of President Doherty, and thanking the local entertainment committee and the Bullock Company for courtesies extended. Upon report of a committee, the meeting approved the suggestions in President Doherty's address, including securing the services of a progress editor, affiliation with other associations, a prize paper, endorsement of the metric system, a wrinkle department editor, reports on sign and decorative lighting, office methods and accounting. The closing papers were on "Hot Water *vs.* Steam Heating," read by Messrs. Porter, Korst, Maunsell and McGee. A resolution was adopted protesting against the 3,500-volt limit proposed by the underwriters with respect to street lines. The treasurer's report showed a balance of $6,000. After fixing on Chicago as the place of meeting of the convention next May, the convention adjourned.

LIST OF CENTRAL STATION DELEGATES.

There was an unusually good muster of central station men present, who gave evidence of their zeal and earnestness by attending three sessions a day steadily in all the fierce heat of the week, in a room whose acoustic and ventilating properties were not of the highest efficiency. The list up to the time when our collection of names closed on Wednesday night was as follows:

DENVER GAS & ELEC. CO.—H. L. Doherty, L. G. Van Ness.

CINCINNATI GAS & ELEC. CO.—A. Hickenlooper, H. C. Hutchison, G. Hafer, C. E. Jones, H. R. Hooper, J. E. Minn, A. J. Pfiester, A. R. Duncan, H. Ayers, E. A. Gast, W. J. Dean, W. J. James, W. E. Beaty, H. K. Prudden, R. R. Woolley.

MONTREAL, CAN.—Lachine Rapids Hyd. & Land Co., W. W. Walbank, R. S. Kelsch.

NEWTON, MASS.—Newton & Watertown Gas Co. W. E. Holmes.

BELLOWS FALLS, VT.—Fall Mt. Elec. Lt. & Power Co. H. Bottomley.

PAWTUCKET, R. I.—Pawtucket Gas & Elec. Co. Orin Smith, Jr., H. A. Peirce.

HACKENSACK, N. J.—Gas & Elec. Co. of Bergen Co. W. J. Jones.

PORTSMOUTH, N. H.—U. S. Navy Yard. T. F. Flannigan.

HAMMONTON, N. J.—Elec. Lt. & Power Co. S. L. Pancoast, Jr.

WOBURN, MASS.—Woburn Light, Heat & Power Co. L. R. Wallis.

COLUMBUS, O.—Col. Edison Co. W. S. Barstow, A. W. Field.

TRENTON, N. J.—South Jersey Gas Elec. Traction Co. F. P. Lupke.

WATERVILLE, ME.—W. & Fairfield R'y & Light Co. R. J. Patterson, G. K. Boutelle.

PLAINFIELD, N. J.—Plainfield Gas & Elec. Co. W. A. McClurg.

PHILADELPHIA, PA.—Brush Elec. Lt. Co. A. J. DeCamp, J. D. Israel. Southern Elec. Lt. Co. A. H. Manwaring, W. P. Conover.

OTTAWA, CAN.—Ottawa Elec. Co. A. A. Dion, J. Murphy.

DERBY, CONN.—Derby Gas Co. R. E. Wyant.

NEWARK, N. J.—United Elec. Lt. Co. J. J. Gaffney, W. W. Titzell.

MARLBOROUGH, MASS.—Marl. Elec. Co. F. O. Barnes.

PLYMOUTH, MASS.—Plymouth Elec. Light Co. E. P. Rowell.

HARTFOBD, CONN.—Hartford Elec. Co. R. W. Rollins.

COVINGTON, KY.—Union Lt., Ht., & Pr. Co. E. Darrow, J. C. Ernst, W. Barnum, W. E. Washburn.

ELMIRA, N. Y.—Elm. Water, Light & R.R. Co. A. E. Walden.

THOMPSONVILLE, CONN.—Enfield Elec. Lt. & Pr. Co. E. H. Tarr.

NEW BEDFORD, MASS.—N. B. Edison Co. C. R. Price, C. H. Gifford.

LITTLE ROCK, ARK.—L. R. Edison Co. J. A. Trawied.
WORCESTER, MASS.—Wor. Elec. Lt. Co. H. H. Fairbanks.
MOBILE, ALA.—Mob. Lt. & R.R. Co. J. H. Wilson.
RICHMOND, VA.—Rich. Pass. Ry. Co.—E. W. Trafford, H. W. Trafford.
PANA, ILL.—Pana Elec. Lt. Co. A. C. Thuelby.
HAMILTON, O.—Ham. Elec. Lt. Co. H. S. Rodgers.
BELLEVUE, O.—Bell. Lt. & Pr. Co. C. M. Lewis.
ELKHART ELEC. CO.—Elk. Elec. Co. C. F. Hewith.
BOSTON, MASS.—Boston Edison Co. C. L. Edgar, L. Stieringer, W. Brophy, L. L. Elden, S. H. Lurer, S. Hosmer.
DETROIT, MICH.—Penin. Elec. Lt. Co. E. S. Phillips.
NEW YORK CITY.—N. Y. Edison Co. N. F. Brady, A. Williams.
BROOKLYN, N. Y.—Brooklyn Edison Co. E. A. Leslie.
AUGUSTA, GA.—Aug. Ry. & Elec. Co. W. E. Moore.
COVINGTON, KY.—C. N. & C. St. Ry. Co. W. W. Tripp.
YOUNGSTOWN, O.—Youngs. Gas & Elec. Co. J. H. Perkins.
CONNEAUT, O.—Municipal Plant. W. E. Fownes.
TOLEDO. O.—Tol. Ry. & Lt. Co. E. J. Bechtel.
SAN ANTONIO, TEX.—S. A. Gas & Elec. Co. G. H. Cushman.
SOUTH BEND, IND.—South Bend Elec. Co. F. A. Bryan.
LONDON, ONT.—London Elec. Co. C. B. Hunt.
YORK, PA.—York Edison Co. J. F. Dusman.
PORT HURON, MICH.—P. H. Lt. & Pr. Co. J. E. Davidson.
TOPEKA, KAN.—Top. Edison Co. C. R. Maunsell, J. P. Guswald.
CHICAGO, ILL.—Chic. Edison Co. S. Insull, L. A. Ferguson, F. Sargent, W. L. Abbott, P. Junkersfeld, J. E. Gilchrist.
MUSCATINE, IA.—Citizens Ry. & Lt. Co. H. T. Fiske.
ABERDEEN, MISS.—Ab. Elec. Lt. Plant. J. F. Endulin.
RED OAK, IA.—R. O. Elec. Co. D. F. McGee
MONMOUTH, ILL.—Mon. Edison Co. R. Ferris.
PORT CLINTON, O.—P. C. Elec. Lt. & Pr. Co. H. C. Taylor.
PEORIA, ILL.—P. Gas & Elec. Co. R. S. Wallace, P. A. Bertrand.
ANACONDA, MONT.—Anac. Copper Mining Co.'s Plant. H. Mc. Nalta.
SPRINGFIELD, ILL.— Spg. Elec. Lt. & Pr. Co. A. V. Schroeder, G. E. Hay.
CAMBRIDGE, MASS.—Cam. Elec. Lt. Co. W. R. Eaton.
HILLSBORO, ILL.—Hill Elec. Lt. & Pr. Co. J. J. Frey.
EDWARDSVILLE, ILL.—Ed. Elec. Lt. & Pr. Co. C. A. Vallette.
CLINTON, ILL.—Clinton Gas Co. W. H. Odwine.
SOMERVILLE, MASS.—Som. Elec. Lt. Co. F. E. Smith.
OMAHA, NEB.—New Om. Thomson-Houston Co. W. J. McManigal, R. A. McLaughlin.
GREENFIELD, O.—Municipal Plant. L. F. Hengle.
JANESVILLE, WIS.—Jan. Elec. Co. P. H. Korst.
MONTREAL, CAN.—Mon. Lt., Ht. & Pr. Co. P. G. Gossler.
EVANSVILLE, IND.—Ev. Gas & Elec. Co. J. W. Gillette.
ATLANTA, GA.—At. Gas & Elec. Co. F. M. Laxton, J. G. Rossman.
MADISON, WIS.—Mad. Gas & Elec. Co. C. H. Williams.
LINCOLN, NEB.—Lin. Gas & Elec. Co. H. H. Scott.
CLEVELAND, O.—Clev. Elec. Ill. Co. M. E. Turner.
WASHINGTON, D. C.—U. S. Elec. Lt. Co. E. S. Marlow, L. E. Sinclair, H. W. Fuller.
GREENVILLE, O.—Green. Elec. Lt. & Pr. Co. D. L. Gaskill.
WEST CHESTER, PA.—W. C. Edison Co. J. E. Pyle.
LOUISVILLE, KY.—Louis. City Ltg. Co. A. M. Worthington.
LAMBERTVILLE, N. J.—Hunterdon Elec. Co. W. S. Newman.
ALBERT LEA, MINN.—A. L. Light & Pr. Co. B. J. Shockley.
JOLIET, ILL.—Econ. Lt. & Pr. Co. J. R. H. Staley.
CINCINNATI, O.—City Elec. Dept. S. H. Weissleder, E. A. Sarran. Cincinnati Traction Co., J. E. Marshall.
WILLIAMSPORT, PA.—Lycoming Elec. Co. E. F. McCabe, E. H. Davis.
SAVANNAH, GA.—Sav. Elec. Co. C. B. Kidder.
SIOUX CITY, IA.—S. C. Gas & Elec. Co. C. C. Gartland.
LEXINGTON, KY.—Lex. Ry. Co. T. D. Murray, R. E. Hunt, J. P. McKeever.
KNOXVILLE, TENN.—Knox. Elec. Lt. & Pr. Co. H. M. Moses.
HASTINGS, ENGLAND.—Corporation Plant. L. Andrews.
CHATTANOOGA, TENN.—Chat. Lt. & Pr. Co. B. T. Burt.
MARYSVILLE, O.—Mary. Lt. & Water Co. H. M. Jones.
GLOVERSVILLE, N. Y.—Fulton Co. Gas & Elec. Co. J. C. De Long.
CONNERSVILLE, IND.—Gen. Gas, Elec. Lt. & Pr. Co. F. Lewis, G. C. Floub.
MT. VERNON, N. Y.—Westchester Lighting Co. J. T. Cowling.
AURORA, IND.—Au. Gas & Elec. Co. F. C. Smith.
ST. LOUIS, MO.—Laclede Gas Co. W. Gallaher.
CEDAR RAPIDS, IA.—C. R. Elec. Lt. & Pr. Co. I. B. Smith.
DETROIT, MICH.—Det. United Ry. J. R. Bibbins.
JOHNSTOWN, PA.—John. Lt., Ht. & Pr. Co. A. Weis.
CHILLICOTHE, O.—Chill. Elec. Ry., Lt. & Pr. Co. L. C. Laube.
TERRE HAUTE, IND.—Terre Haute Elec. Co. C. T. Mordock, J. P. Clark.
MACON, MO.—N. W. Elec., Ht. & Pr. Co. T. W. V. Blees.
BRAZIL, IND.—Terra Haute Elec. Co. E. C. Deal.
CANON CITY, COLO.—Colo. Elec. Power Co. N. T. Wilcox.
ST. PAUL, MINN.—St. P. Gas Light Co. A. Washrop.
GALION, O.—Elec. Light Plant. H. C. Dye.
LIMA, O.—Lima Elec. Ry. & Lt. Co. J. A. Bendun.
VINCENNES, IND.—Vin. Elec. Lt. & Pr. Co. H. W. Frund.
SPRINGFIELD, O.—Spg. Lt. & Pr. Co. J. H. Miller, J. D. Rodgers.
BATESVILLE, IND.—Bates Elec. Lt. Co. J. A. Hillenbrand.
COLORADO SPRINGS, COL.—Col. Spg. Elec. Co. G. B. Tripp.

Names registered after the compilation of the above list will be noted in our next issue.

Abstracts of Papers.

The programme of the Cincinnati meeting comprised almost a score of subjects, not including several formal reports of committees. Owing to the fact that in many cases two or more persons contributed to the discussion of a subject, the total number of writers aggregated more than two score.

Arc and incandescent lamps were represented by three papers, and two papers dealt with sign and decorative lighting. In this classification should also come what was perhaps the most valuable contribution to the proceedings of the Convention—the third progress report of the committee for investigating the photometric value of arc lamps.

LAMP EFFICIENCY.

On the subject, "What efficiency Lamp Should be Used, and How May This Efficiency be Determined For Any Particular Station," five papers were contributed—namely, by Messrs. Doherty, Doane, Van Ness, Willcox and Marsh. Mr. Doherty considered that the efficiency of the incandescent lamp, assuming that 16-cp lamps are used, should be placed at that point where the cost to the central station for the supply of current just balances the cost of lamp renewals; and that when this point has been determined for a 16-cp lamp, then lamps of other ratings should have an efficiency that would bring the cost of lamp renewals to the same point per kw-hour consumed. In other words, when lamp renewals for lamps of a given efficiency cost more than it would cost the central station to supply additional current to yield the same amount of light from a lamp of lower efficiency, they should adopt this lower efficiency lamp. The paper by Mr. Doherty formed the basis of a discussion of the subject by Messrs Doane, Van Ness, Willcox and Marsh.

Mr. Doane agreed with the opinion put forth by Mr. Doherty, and gave a table comparing the economy of using lamps of several efficiencies. If, for example, the ultimate life of a 4-watt lamp is represented by 375, that of a 3.5-watt lamp is 210, and that of a 3.1-watt lamp is 130. That is to say, it is as economical to use a 3.1-watt lamp for 130 hours as it is to use a 4-watt lamp for 375 hours. Mr. L. G. Van Ness considered that the life of 16-cp lamps on perfect regulation is 420 hours for 3.1-watt lamps; 750 hours for 3.5-watt lamps and 1,500 hours for 4-watt lamps; and that lamps should be changed periodically by the company, the changes being made at such intervals that lamps burned until midnight will not exceed the normal life. On this basis the most desirable efficiency of lamps will then be determined by five factors, namely, the average regulation of the circuit; the generating costs that are strictly proportional to the output; investment per kw-capacity of the station; the average consumption per lamp per year and the charge per kw-hour to consumer. Each of these points was taken up and discussed in detail, and the conclusion arrived at that the best way to answer the question propounded in the title of the discussion is to face the situation squarely and each figure it out for himself. Mr. Van Ness showed how the different factors may be determined and correlated.

Mr. Francis W. Willcox discussed the question under a number of heads as follows: definition of the term, "best efficiency;" the cost of lighting; useful life and lamp cost for the different efficiencies of the 16-cp lamp; is the operating cost the basis? how may net

earnings be increased; the efficiency giving minimum cost to consumers; the case stated; the question of regulation; the effect on rates; how lamp renewal costs may be offset; the cost of other units than 16-cp; the 8-cp lamp; the lowest units for economy and the ease of sign lamps. The general conclusions of Mr. Willcox are as follows: 1. The best available economy in central station service for the 16-cp is 3.1 per candle. The 2.75-watt lamp is the most desirable for average rates in use. 2. The 3.1-watt lamp can be used to advantage even when the voltage is kept 4 per cent. high, with fluctuations going still higher. 3. No central station, therefore, which supplies current by meter should use lamps of lower economy than 3.1-watts. 4. The best economy in smaller candle-power units is that which keeps the cost of renewals per kw-hour about the same as the 16-cp costs. This basis gives a 3.6-watt per candle economy, or better, for 8 and 10-cp lamps. 5. As very low candle-power units are used chiefly for sign lighting, they can be more liberally treated than the basis of the foregoing paragraph demands. An economy of 4 watts per candle-power is desirable for 4 and 5-cp units, this being reduced to 5 watts per candle-power for three and two candle-power lamps owing to the extreme tenuity of filament used in the same.

Mr. Converse D. Marsh considered as a double fallacy the argument that low economy lamps are preferable to high economy lamps because finer regulation is required for the latter. The best possible regulation should be provided regardless of the lamp efficiency. Central station men should bring the regulation up to the best practicable point with a view to best satisfy the consumers. It will then not be necessary to waste energy on 4-watt lamps. The central stations which have advocated high economy in incandescent lamps have been, with rare exceptions, those that have done a large volume of incandescent lighting and have paid handsome dividends. Mr. Marsh considers that from a strictly engineering standpoint it would seem a simple matter for the members of the National Electric Light Association to arrive at a proper conclusion if a table were given them, fixed factors being entered and blanks left for the variables, which each manager could insert for himself. Business policy, however, should be ever kept in mind in considering the technical branch of central station operation. Mr. Marsh said that a good incandescent lamp is to-day sold for but slightly more than the cost of a lamp chimney, though the former goes through over 50 mechanical, chemical and electrical operations, some of them requiring the highest technical skill. One of the prime factors in producing this condition has been the employment of 3.1-watt lamps on a large scale, the increased output having aided the lamp maker in reducing his cost of manufacture.

FREE LAMP RENEWALS.

On the subject, "Are Free Lamp Renewals Desirable?" discussions were contributed by Messrs. English, Smith, Little and Green. Mr. Jas. English said that the companies he has been managing have after some experimenting adopted the plan of free renewals, and have found it beneficial and wise. Experience in renewing lamps demonstrated that some definite system should be employed, based upon the following desiderata: First, lamps should be renewed often enough to insure the maintenance of a good candle-power during the service, or a limitation in the fall of candle-power; second, the renewals should be made in such a manner as to cause no annoyance to users; third, renewals should be made often enough to obviate practically the necessity for customers calling for new lamps to replace those burned out; fourth, the system should be one that would effect the desired end in the most economical manner to the company. Mr. Smith said that his companies had adopted the principle that all lamps on circuits should be changed once in 400 hours. All lamps removed are sorted by a photometer and those put again into stock that measured 16 candle-power. Every lamp on the main is changed four times per year, usually in February, May, August and November, it having been found that this results in very few lamps being used over 400 hours. 40 per cent. of the lamps removed are found to measure 16 candle-power and are sent out again. The experience of ten years demonstrated that all the lamps in service are at least 14-cp, and not at any time more than 2 candle-power below the nintial candle-power. The cost to the company of this method is at least no greater than that of the ordinary method of making free renewals; the general effect on business had been excellent.

Mr. F. Elwood said that for a number of years his customers bought all their lamps, either from the company at cost, or elsewhere as they saw fit. The experience with this system was very unsatisfactory and finally the company adopted the system of free renewals. As an example of the advantage of free renewals, a customer using a dim lamp of, say, 12-cp is paying for, say, 37-watts. If given a new lamp and consuming, say, 50-watts, he will be satisfied with the light and willing to pay for the additional current. The central station will thus soon get back the cost of the lamp in increased revenue. New lamps are not given in exchange for broken ones. While Mr. Smith has not adopted the method of sending men to replace lamps, he confesses that a systematic inspection of all lamps on circuits would be a very good thing. All the lamps returned are photometered, and those giving 14 candle-power are used again near the center of distribution, where the voltage is a little higher. Mr. Smith does not believe in furnishing free the first installation of lamps, except in residences, for the reason that in a great many instances the return per lamp will be very small, and he considers that the cost of the first lamps will not keep away any desirable customer.

Mr. F. W. Little said that the question of free lamp renewals had been but lately considered by the Peoria Gas & Electric Company. At present, however, it is considering the plan of selling lamps at cost and charging a nominal price for renewals when customers turn in burned out lamps originally obtained from the station. He considers that this will insure the use of first-class lamps on the circuits and the freer use of current owing to the lower cost of the lamps, without entirely cutting off the revenue from lamp sales. If results indicate that the step is unprofitable, the loss will not be as serious as free renewals, if furnished; while if results indicate that further reduction in the price of lamps will be advantageous, the company will be in a favorable position to make it.

Mr. W. J. Green said that from 1888 to 1893 his company furnished free lamp renewals. In 1892, however, it became evident that the net earnings were not keeping proper pace with the growth of the plant and the increased investment, and two reforms were then resorted to; one was the adoption of a minimum charge proportional to the maximum burning lamps; the other the discontinuance of free lamp renewals. These changes were soon followed by the adoption of a two-rate system in connection with a minimum charge, so that the consumers upon whom the heavier cost of lamp renewals fell were many times compensated for such expense, by the lower cost of service. Mr. Green gave several reasons for continuing the present system. One is the extraordinary one that the check which it gives to growth of business resulting from charging for lamp renewals is desirable, in view of strong competition with gas and difficulty in providing for increased capacities owing to manufacturing delays and engineering problems. Another reason is lack of facilities at present to carry a supply of lamps and conveniently serve consumers to lamps from the office. Still other reasons are avoidance of extra time required on the part of the management, and extra cost for labor, lamps and for storage room; and the benefit to supply houses of supplying lamps, which insures their good will.

200-VOLT LAMPS.

Mr. Fred W. C. Bailey read a paper of considerable length entitled, "Performance of Present 220-Volt Lamps," giving results of lengthy tests. At least 50 lamps of each make were procured, and every lot consisted of two separate orders placed with different firms. More than 50 lamps were purchased from several makers, and from these lots 50 lamps were selected at random and set aside for tests. The manner in which the tests were conducted is described, and numerous target diagrams and life curves are given, there being 37 figures in the paper, including a number of diagrams of spherical candle-power. The paper does not formulate any general conclusions based upon the tests. It appears, however, that with respect to candle-power, out of 14 lots of lamps tested, one lot did not give a single lamp that came within a target limiting the candle power to 1½ candles above or below the normal rating. Only five lots showed a percentage above 50 per cent., and three lots a percentage of 80 or above. It is stated that at least 80 per cent. of all the selected lamps should have come within such a target. With respect to economy, those coming within a target limiting the lamp to one-half watt per candle above and below the rating, none of the lamps of two lots were within the target; only four lots were above 50 per cent. and three lots reached 80 per cent. or higher. In the life tests twelve lamps of each lot were operated, being selected as closely as possible to the rated candle-power efficiency. The results are tabulated in terms of arbitrary candle-power areas, and no general discussion of the test is given. A final table shows that the average initial watts per horizontal candle-power varied in 14 lots from 3.36 to 5.30; that the average watts per horizontal candle-power during the useful life varied from 3.73 to 5.88 watts; that the average watts per horizontal candle-power during

1,500 hours varied from 4.38 to 6.08, and that the estimated period of useful life varied from 467 hours to 3,502 hours.

Measurements made of mean spherical candle-power showed that the ratio of mean spherical to mean horizontal candle-power was quite uniform, averaging about 82 per cent. for "double oval" filaments.

SIGN AND DECORATIVE LIGHTING.

Sign and decorative lighting was the subject of two papers, one by Mr. Russell Spaulding, having the title, "Display Lighting, Signs and Decorations," and the other by Mr. E. J. McAllister, on "The Possibilities of Sign and Decorative Lighting." In the paper by Mr. McAllister it is stated that in New York City current is used for out-door lighting equivalent to that consumed by 100,000 16-cp lamps, or about 10 per cent. of the entire lighting current. Illustrations accompanying the paper show a number of examples of sign and decorative lighting, and the business side of such lighting is discussed both from the standpoint of the central station and the user. It is stated that one lighting company in a large eastern city has adopted the policy of furnishing and maintaining any ordinary electric sign or decorative illumination designed by a customer, upon the agreement of the latter to use it a given number of hours per year, the consumer paying for current at regular meter rates. Other central stations have followed the practice of making a liberal special rate to this class of lighting. Several of the latest novelties in the way of systems of decorative and sign lighting are described.

The paper by Mr. Spaulding is brief, being principally an introduction to a reprint of a paper by Mr. Luther Stieringer on "The Evolution of Exposition Lighting," originally read before the Association of Edison Illuminating Companies, and to an article reprinted from these columns, entitled, "From Christmas Tree to Pan-American."

RATES.

One of the most important parts of the programme of the meeting was a series of papers on "Rates," the authors being Messrs. Doherty, Wallis, Patterson, Scovil, Phillips, Dow and Ferguson. Mr. Doherty said that much success had been met with in introducing at Denver and elsewhere the system of rates which he outlined in a paper read before the association at its convention held in May, 1900. According to this system, as applied at Denver, every consumer pays $12, plus $6 for each meter more than one, plus $1.80 per lamp connected, plus 5 per cent. per kw-hour for current. From the aggregate a discount of 50 and 10 per cent. is allowed. This system of rates has been adopted at Denver, Colo.; Madison, Wis.; Lincoln, Neb., and Quebec, Canada, with excellent results. Immediately upon the adoption of the scheme in Denver the output and maximum demand began to increase. From April to January the connected load increased 8 per cent., the maximum demand 32 per cent., and the output 70 per cent., the latter increase being confined to approximately 50 per cent. of consumers; some of the latter increased as much as 400 per cent. The increase in consumption is attributed largely to the adoption of the lower rates and not particularly to the system of charging. It is felt, however, that if a system of charging had been adopted based largely upon consumption, the rates would have had to be very much less to have brought about the same increase in output. When customers found that they could buy additional current at a much lower rate, they felt more inclined to use it liberally, and many of them are now paying a gross amount greater than they paid before this system of charging was adopted.

The paper of Mr. L. R. Wallis related to the "Foresee" system of charging. This system has been applied in a city of 30,000 inhabitants since July 1, 1901. The consumers contract with the company for a period of one year, agreeing to pay for the capacity demanded in 16-cp lamps or their equivalent, at certain definite tariff rates, plus a meter rate of 6 cents per kw-hour. The legality of this method was questioned by certain consumers, and an appeal was taken to the Massachusetts State Board of Gas and Electric Light Commissioners, who after thorough investigation rendered an opinion favorable to the company. The board in its opinion said, that "The system is evidently intended to increase the profits of the company by increasing its output, and at the same time to reduce the price to a large majority of its customers, enabling them, without a proportionate increase in their bills, to use lights much more freely and with increased convenience."

Mr. Ralph J. Patterson described a system in operation in Waterville, Maine. The schedule rates are based upon the number of lamps contracted for, and a customer is allowed to make that number anything he chooses, except in some residences where 10 lights or less is the actual number installed, in which case the actual number installed is taken. According to the rate schedule for residences, a house using 1 lamp would pay $0.80 per month; for 5 lamps, $1.41 per month; for 10 lamps, $2.46 per month, and for 20 lamps, $3.52 per month. The cost above 20 lamps is 17½c. each per month. A device is installed which will not permit the simultaneous use of more lamps than have been contracted for.

Mr. Samuel Scovil criticised both the Wallis and Doherty methods of charging. He said that the former is sadly deficient, since in dividing the total installation and fixed cost by the capacity demanded, or to be demanded, it fails to take into account the fact that there is a great difference in the cost of a distribution system for 500 customers and one customer, and the cost of serving 500 customers as compared with serving one customer. Mr. Doherty with his charge "per customer" in addition to other charges, does provide for some of the difference which a company can profitably allow in serving the two classes of customers above considered. But after adopting what was figured to be an equitable system of charges, these were reduced by a discount of 50 and 10 per cent, thus reducing the guarantees which the great bulk of customers are asked to make, to such a small amount that they do not have to give them any consideration whatever. Mr. Scovil considered that all Mr. Doherty's system is doing in Denver is to allow him to carry on his competitive war on lines that tend to increase the load factor of his station, so that if there is any profit per unit in selling current at the price fixed by him, he gets all there is in the business. He considers that a correct system of charging would be one that bases the cost of service to the consumer in the main on the hour's use of the capacity demanded by him, and that the tariff schedule should be proportionate to the cost. These costs consist of those expenses which are fixed and those which are proportional to the kw-hour output. There is, however, a diversity of opinion as to what expenses are fixed and what are proportional to the output, and until an agreement could be arrived at on these points, Mr. Scovil considers that no universal system of tariff is possible.

Mr. E. F. Phillips said that his station has made a radical departure in the matter of rates and adopted a system whereby the consumer was required to pay at the rate of 16 cents per kw-hour for the first two hours per day of connected load, or 60 hours monthly; all current used in excess of this to be paid for at 5 cents per kw-hour, the total bill to be subject to discount if paid within 10 days of date of bill. This departure had the effect of widening out the curve of the peak load and brought quite a noticeable amount of new business. The net earnings per kw-hour of output fell off somewhat, yet the net earnings to the company for the year showed a healthy increase. During this time the regular rate for power service had been put at 10 cents per kw-hour; this was changed to 10 cents per kw-hour for the first 30 hours per month per kilowatt connected, and excess current charged for at 5 cents per kw-hour. Within a year the power rate was changed to 10 cents per kw-hour for the first 30 hours of "maximum demand" instead of "connected load." This brought about a very noticeable increase in power service and a corresponding change in the light load curve. In the meantime the two-hour per day rate had been applied to the residence service, and produced general satisfaction; the method pursued was an arbitrary one based on the average use, this to form the maximum demand for the 16 cents rate, with excess current at 5 cents and minimum bill of $1 per month. The average earnings per kilowatt of output showed in the residence district a decided drop, yet the net earnings were increased. This rate is the one still in use for residences.

The next step was the adoption of a 1-year contract system on the maximum demand plan and a change to one hour per day at the 16 cent per kw-hour price, excess current at 5 cents per kw-hour —the maximum demand contract, however, to cover all electrical service used by the customer. This has proved the most popular of any plan yet instituted and is the one in general use by the company at the present time for all service except residences; but it is optional with the customer as to whether he shall take the open order at 60 hours per month of connected load, or 30 hours per month on maximum demand. In the case of arc lamp service, however, the customer is required to take the maximum payment contract for one year. This maximum demand arrangement necessitated the installation of the Wright demand meter in all cases where connected load was known to be in excess of the demand.

Mr. Alexander Dow stated that after five years' experience with differential rates, he is of the opinion that when a reduction of rate is to be made, it should be done in such a manner that the reduction will apply on the business which is being done at a profit, and not on the business which is being done without profit, or at a loss. The theory of equity requires that each kw-hour sold should bring a uniform profit to the company. If any current is sold at a loss, a higher margin of profit is necessary with respect to the business that is done at a profit. Mr. Dow said that he nevertheless recognizes that the ideal service is that which operates with a constant load 24 hours a day, and that the ideal rate is that which is uniform to all users, regardless of the time of day or season of the year. Therefore advantage should be taken of every class of business which will straighten the load curve. This may be done in some cases by obtaining a day load which can be switched off at dusk; in other cases, as in New York, by linking together districts whose periods of maximum load succeed one another; or possibly in future by using such a large proportion of storage batteries that inequalities are thereby done away with. While at present the load curve cannot be so straightened as to warrant a uniform rate, efforts should be made in that direction; and while recognizing the necessity and the equity of the differential rate under present conditions, we should persistently endeavor to so modify these conditions that the necessity for the differential rate will ultimately disappear.

Mr. Louis A. Ferguson considered that the necessity for the adoption of an equitable rate of charging is becoming more and more apparent, because on all sides city authorities are bringing forward the cry of discrimination, and sooner or later those companies that are not prepared to go before their city council or their State legislature and demonstrate conclusively that the system on which they charge for supply of electricity is equitable, will be subjected to unfair uniform kw-hour regulations. Mr. Ferguson believes that an equitable system of charging, which is based on underlying principles of cost of production, will not only withstand the attacks of the city and State authorities, but will return to the stockholders a fair dividend on their investment.

Mr. Ferguson gave an account of the different methods of charging that had been pursued by the Chicago Edison Company, none of which were satisfactory until the adoption, in 1897, of the Wright demand system in modified form. Each monthly bill is based upon the customer's actual maximum in that month, and during each of the six winter months the customer is charged the full rate of 20 cents per kw-hour for all electricity consumed monthly until the consumption reaches the equivalent of 45 hours' use, or the maximum number of lamps lighted simultaneously, as indicated by the Wright demand meter; 10 cents per kw-hour being charged for all electricity consumed in excess of that amount. During the summer months the full rate is charged for light consumption until it reaches the equivalent of 15 hours' use of the maximum number of lamps lighted simultaneously, and for all electricity in excess of that amount the rate of charge is 10 cents per kw-hour. For the low-rate portion of the bill, a discount is given, the amount ranging from 5 per cent. to customers whose low-rate portion was 100, and increasing by 5 per cent. for each 100 of the low-rate portion, making the maximum discount 50 per cent. in the case of a customer whose low-rate portion is 1000. Within the last year this method has been simplified by abandoning the difference between summer and winter rates.

In charging for power, the full rate is 10 cents per kw-hour for the first 30 hours' use of the maximum power per month. The low-rate is 8 cents per kw-hour for the second 30 hours' use, 6 cents for the third 30 hours' use, 4 cents for the next 450 hours' use, and 3 cents for the next 180 hours' use. The low-rate portion of the bill is subjected to discount ranging 15 per cent. on amounts from $20 to $40, to 40 per cent. on amounts ranging from $100 to $200. These rates for power give a range from 10 cents to 2.88 cents per kw-hour as a minimum.

In Chicago, at present there are in use a total of 13,022 Wright demand meters and 15,633 recording meters, the income from the customers using Wright demand meters being $986,560 for the fiscal year ending March 1. The average discount from the list is 31.1 per cent. for light and 49.1 per cent. for power. Of the Wright demand meters 94 per cent. are for 10 and 25 amperes, showing that the bulk of the business on this system is with relatively small customers. The total number of customers on the book is 18,623, of which 61.7 per cent. are on the Wright demand system. Of 2,737 power customers, 50.7 per cent. are on the Wright demand system. The total investment in meters of all kinds is $353,000, of which 23 per cent. is for Wright demand meters. The load factor of the Chicago companies for the last fiscal year was 27.1 per cent., showing an average daily use of the system's maximum for 6½ hours. Before adopting the Wright demand system of charging, the total yearly expense per recording meter, including salaries, supplies, repairs and renewals, was $2.95 per recording meter. Last year the total yearly maintenance expense per recording meter, including the same items, was only $1.85, showing that the cost of maintaining Wright demand meters is inconsequential.

Criticism has been sometimes made of the method used in Chicago, on the ground that the company might do a large amount of unprofitable business, owing to the fact that there is no guarantee to the company that the consumer will pay for at least one hour's daily use of the maximum demand. An analysis shows that of the total income from Wright demand business, only 8.6 per cent. of the total comes from customers using the equivalent of the maximum demand for less than one hour daily; and, furthermore, that the ratio of gross delivery to full rate lamp hours of these "shortage customers," is 57.3 per cent. Thus the actual amount of business which falls short of using the maximum demand one hour per day is only 3.67 per cent. After five years' experience with this system, Mr. Ferguson said that he is strongly convinced of the necessity of some such equitable tariff being adopted by all electric light companies in every city and town, not only in justice to the consumer, but to protect the investor from loss of revenue resulting from injudicious contracting and unfair municipal price regulation, both of which will become inevitable without a proper system of charging.

LIQUID BOILER FUEL.

Two papers were on the subject of "Liquid Fuel"—"Boiler Firing with Oil," one by Mr. Jas. W. Warren and the other by Mr. H. T. Edgar. Mr. Warren gives an account of his experience with the California petroleums, which are of asphaltum base, and carry with them about 30 per cent. of asphalt. At the station of the Los Angeles Electric Company the fuel is pumped from a main storage tank to the furnace supply tank of 100 barrels capacity, where it is heated to 80° F. It is then pumped at 20 lbs. pressure through pipes within the breeching of the boilers, where it is heated to 190° F., and then passed to the burners. The burners are of the spray type, using steam as a medium for spraying the oil. Each burner has an evaporation efficiency of 3,000 barrels of water per hour from and at 190° F. A high-temperature thermometer is used in the smoke pipe, in order that the amount of air necessary for perfect combustion may be graduated. By the use of the thermometer the fireman can so regulate the burners that each boiler will do its proportional amount of work, the temperature of the stack being kept at 450 degrees. The evaporative efficiency of California oil as compared with the same weight of average good steam coal is 20 per cent. higher. There is a saving of 75 per cent. in the cost of keeping the boiler in clean condition, and the use of liquid fuel solves the smoke problem, and also reduces the deterioration of the steam generating apparatus 75 per cent., and of the repair account 80 per cent. In conclusion, Mr. Williams says that the record of results obtained from the use of liquid fuel in Southern California stands out so prominently in favor of said fuel that many of the large steam generating plants in the northern part of the State have abandoned the use of coal in favor of liquid fuel.

Mr. H. T. Edgar gives the result of his experience in burning Texas fuel oil at the electric light plant at El Paso, Tex. The oil is stored in steel tanks buried in the ground, and is drawn from the tanks through a 1½-in. iron pipe, which discharges through a 1-in. pipe into a small chamber about 14 ins. in diameter by 2 ft. 6 ins. long, placed by the pumps. The oil enters this chamber at one end, passing through a partition of very fine wire gauze, and at the other end comes in contact with a coil heated with the exhaust steam from the pump, thus raising the temperature of the oil to about 145° F. The oil is sprayed from the burners by steam, and in order to insure a steady pressure an auxiliary air chamber is required. It is stated that a very great saving has been made at the El Paso station through the substitution of oil for coal. It is claimed by the advocates of fuel oil that four barrels of 42 gallons are equal to one ton of good bituminous coal. Results of tests made by the waterworks company of El Paso show that the cost of burning fuel oil is but half the cost of burning coal, when the coal costs $5 per ton and the fuel oil 70 cents per barrel.

HOT WATER VS. EXHAUST STEAM HEATING.

This subject was considered in papers presented by Messrs. J. F. Porter, P. H. Korst and C. R. Maunsell. Mr. Porter gave his experience with a hot-water heating plant which supplies 50,000 feet of radiation placed in residences, business houses, offices and schools. The plant had been in operation since 1889, and the repairs for the first two years has amounted to less than $400. During these two years the plant was operated without any back pressure on the engines, but owing to increased heating business and the severity of the past winter, it was found necessary to weight the back pressure valve from 3 to 5 lbs. when there was but little electric light or power load; but during the late afternoon and until midnight there was ample steam to furnish heat without back pressure on the engines. In conclusion, Mr. Porter says that he believes that a hot-water heating plant of sufficient capacity to use the exhaust steam of a combination railway and lighting station would prove satisfactory to any operating company.

Mr. P. H. Korst in his paper also gave testimony in favor of the hot-water system. The advantage of this system he stated to be the utilization of exhaust steam without putting back pressure on the engines, and that it even enables engines to be run condensing. Mr. Korst said that his customers, after two seasons of use, are highly pleased with the hot-water system, and recommend it to all inquirers. An objection to charging by the meter system is that customers will thereby be encouraged to keep down the supply, with the result that the system is discredited when the temperatures of a house or store is thereby kept low. He considers that the most satisfactory system is to charge according to the cubic contents of the space to be heated, with additions for variations in exposure of walls, etc., and then install enough radiation to keep the rooms comfortable at all times.

Mr. Maunsell gave his experience in the operation for five years of an exhaust steam-heating system at Topeka, Kan. About one-sixth of the total investment of his company is in a steam-heating system, and this has proved a particularly good investment. He considers that the effect of back pressure while operating an exhaust steam-heating system is not such a serious matter as many have been led to believe, and a table is given to sustain this opinion, the table showing the number of hours and the different pounds of pressure on the mains throughout the year. The maximum back pressure is required but a few hours during the heating season of 5,760 hours, or 8 months, and during 872 hours no back pressure is required. Steam is supplied by the flat rate or by the meter system. The rates are 30 cents per sq. ft. for direct radiation per season; 35 cents for indirect radiation, and 20 cents for cooling coil. The meter rate is 60 cents per 1,000 lbs. of water. A square foot of radiation is about 3 ft. of 1-in. steam pipe. Indirect radiation consists in placing the piping in such a manner that cold air is passed over it from any source to extract the heat. A cooling coil is necessary to extract the remaining heat from the water before it is discharged to the sewer, as without this device considerable waste of heat would occur.

CREOSOTING LINE POLES.

With this title Mr. W. E. Moore considered the question whether it pays to creosote wooden line poles for telephone line work, and gave the results of the experience of the Augusta (Ga.) Railway & Electric Company. Some three years ago this company bought a plant for creosoting poles and railway cross ties. The poles are placed within a cylinder, and after being subjected to a steaming process for a period of 4 to 6 hours, a vacuum is created in the cylinder by means of a pump, and the cylinder heated by superheated steam in coils in the bottom to about 350 degrees, this process lasting from 4 to 6 hours. Connection is then opened with a creosote oil storage tank, and the atmospheric pressure forces the oil into the cylinder until it is filled. After this an oil pressure pump is started, and a pressure of 60 lbs. per square inch maintained for a period ranging from 2 to 4 hours. The oil is then drained from the cylinder into the storage tank, and steam is left circulating in the superheating coils in the cylinder for about an hour in order to decrease oil drippings from the timber. Steam is circulated through superheating coils located in the bottom of the cylinder throughout the entire process, which ranges from 16 to 24 hours. The cost of creosoting is approximately $20 per thousand feet, board measure, or about twice the first cost of poles. It is thought that the life of creosoted poles will be prolonged four to six times that of untreated timber. The only objection to creosoted poles is in their handling, which inflames the hands of the workmen. The electric conductivity of poles is also increased to such an extent that linemen can no longer depend upon the poles to insulate them from ground when handling from one to three thousand volts.

PHOTOMETRIC VALUES OF ARC LAMPS.

The third progress report of Prof. C. P. Matthews on the investigation of the photometric value of arc lamps deals with tests of 6.6 ampere direct and alternating-current enclosed arc lamps; tests of 7.5 ampere alternating enclosed arc lamps; tests of 450-watt arc under varying conditions of energy, supply, etc.; tests of various brands of high and low grade carbons in a 9.5 ampere open arc; and a consideration of illumination on a plane normal to the ray at different distances from the lamp.

Five direct-current 6.6-ampere enclosed arc lamps were tested with the following results: With no outer globe and opalescent inner globe the watts per mean candle power were respectively, 1.07, 1.37, 1.24, 1,27, 1.3 and 1.28. With a clear outer globe and opalescent inner globe corresponding values of watts per mean hemispherical candle power were respectively 1.2, 1.29, 1.35, 1.24, 1.38 and 1.37. A conclusion arrived at is that for street lighting the best distribution is obtained with closed base inner globes.

Three 6.6-ampere alternating-current lamps were tested with the following results: With no outer globe and an opalescent inner globe the watts per mean hemispherical candle power were 1.86, 2.06 and 1.76; with clear outer and opalescent inner globe the corresponding quantities were 2.25, 2.06 and 1.55. Three 7.5-ampere alternating current series enclosed lamps were tested with the following results: With no outer globe and an opalescent inner globe the watts per mean hemispherical candle power were respectively 2.28, 1.94 and 1.8. Comparing the result of the above tests, Prof. Matthews says the average for the direct current 6.6-ampere lamps with opalescent inner and clear outer globes is 1.31 watts per c.p.; for the alternating current 6.6-ampere lamps with opalescent inner and clear outer globes 1.92 watts per c.p.; and for alternating current 6.6-ampere lamps with opalescent inner globe and with shade is 1.48 watts per c.p. These figures show that while the alternating current lamp taking 6.6 amperes is inferior to the direct-current lamp of the same current capacity in light producing power below the horizontal, the use of a shade in the former brings down the specific power consumption to within 13 per cent of that of the direct current lamp. The mean power factor of the 6.6-ampere alternating current lamps is .88 and of the 7.5 lamps .83.

The tests of a 450-watt arc were made under varying conditions and the results show that 450 watts expended between a given number of carbon points may produce, under varying conditions such as occur in every day practice, widely different values of candle power in useful directions. These variations depend upon whether the current is direct or alternating, the arc open or enclosed, the globe clear and opalescent, the arc shaded or otherwise, the current large or small. Another conclusion is that no advantage comes from the substitution of the 6.5-ampere arc with clear globe for the 9.5 ampere open arc in so far as distribution of light is concerned. Still another conclusion is that if the open and enclosed arc tested were suspended at the same height, say 25 feet, they would produce equal illumination at a suspension of about 117 feet from the lamp, but beyond this distance the enclosed arc would have the advantage over the open as a street illuminant. The superior candle power distribution of the enclosed arc is clearly and chiefly through the use of the opalescent inner globe. This globe becomes itself highly luminous, thus strengthening the intensities near the horizontal.

Tests were made of high and low grade carbons, the primary object being the determination of the relative candle-power obtainable when the carbons were burned in 9.5-ampere 450-watt open arcs. The high grade carbons when solid gave more candle power at each of the three angles of measurement. When however they were cored, they fell behind the low grade carbon throughout one of the angles. This is doubtless due to the deep crater formed in the cored carbon. Although high grade carbons give superior candle power they showed somewhat shorter life when burned open, the difference being about 9 per cent for the positive, but slight for the negative. The report concludes with an account of experiments on the height of a lamp with respect to the illumination furnished at different points.

ADVANTAGES OF GAS ENGINES FOR CENTRAL STATION WORK.

Mr. Chas. H. Williams presented a paper with the above title, in which he gave an account of the results of operating a gas

engine electric generating plant at Madison, Wis., supplemented by data gathered from other gas engine stations. Tests made of the steam generating plant in the Madison station showed that the efficiency of energy transformation is 6.6 per cent. under favorable average working conditions. It is stated that while this efficiency may appear low to a great many central station men, it probably represents much better than the average conditions; and that the large majority of the smaller stations in operation throughout the country will not transform more than from 2.5 per cent. to 4 per cent. of the energy of the coal into dynamic energy. In the case of the Madison gas engine plant, 20.8 per cent. of the original number of heat units contained in the pound of coal that was put into the gas generator was utilized, or 3016 heat units for useful work per lb. of coal, against 1008 per lb. with steam. Mr. Williams discusses in his paper a number of points connected with the operation of gas engines, and gives data as to the thermal value of different kinds of gas. Data are also given as to the operation of gas engine central station plants located at Mankato, Minn., and Oshkosh. Wis.

At Mankato there are installed one 85-hp and one 125-hp gas engine, and recently there have been added two additional 50-hp engines. These furnish power for 107 32-cp lamps, 63 2,00r cp open arcs, 35 commercial multiple arcs and 1,800 16-cp incandescent lamps, together with a motor load of 60 horse-power. The books of the Mankato company show that the amount of gas used for the six months ending January, 1902, was about 78 per cent. increase over the previous gas output, and that this increase lowered the cost of the gas to the company 8 cents per thousand; this was exactly the same as giving them an additional profit of 8 cents per thousand on every thousand sent out to its regular customers. Mr. Williams considers that it is perfectly legitimate for that company to credit the gas engine account with 8 cents per thousand on 16,000,000 cubic feet of gas, that being its actual output, or $1,280 per annum; and this credit amounts to 18 per cent. of the total amount which it had paid for power previously.

At the Oshkosh plant there were installed two 50-hp and two 125-hp gas engines, and the output is 45,000,000 cubic feet of gas per year. The extra output here lowered the cost of gas in the holder 8 cents per thousand, so that the gas engine should be credited with $3,600 per year due to decreased cost in gas generation.

There are also installed two gas engines at Red Wing, Minn., two at LaCrosse, Wis., and three at Appleton, Wis., all running on illuminating gas. The Bradford, Pa., central station has three 150-hp and one 210-hp gas engine, which have been in operation for three years, and that company is just installing an additional 210-hp engine. The manager of the plant, Mr. J. H. Rose, speaks highly of this installation. Formerly steam engines were used, the boilers being fired with gas. The last days of the steam plant showed a consumption of 51.09 cubic feet of gas per 1hp, while with the gas engine the consumption is but 13.6 cubic feet per electrical horse-power, which reduced to indicated horse-power would be equivalent to between 11 an 12 cubic feet. The gas engine repairs for the year 1901 amounted to $196.90, including extra exhaust valves for all the engines.

Several gas engine plants for furnishing power to manufacturing establishments were referred to. In conclusion Mr. Williams says that so far as reliability of operation is concerned, he believes the earlier manufacturers are more to blame than anyone else for what trouble was experienced, too many units having been sold with the assurance that anyone could run them. The same advice carried out at a steam station would put it on a losing basis. There are a very few small details which demand intelligence and regular attendance of the gas engine, and if these proper conditions are maintained the engine will operate satisfactorily, and the attendance troubles are over.

THREE-PHASE VS. TWO-PHASE FOR CITY DISTRIBUTION.

Mr. B. A. Behrend, in a paper with the above title, said that the question whether or not the three-phase current is superior to the two-phase current for the distribution of light and power in cities, has been argued for the past eight years. At first, there were a great many advocates of the two-phase current, on account of the greater simplicity of this system. Looking to-day over the installations of alternating-current systems for city distribution, we find the fact established that the three-phase distribution has been preferred to the two-phase distribution in the majority of plants.

That system will be most favorable for distribution of light and power in which the potential on one phase is as little as possible affected by a change on load on another phase. This may be considered the criterion by which to form an opinion of the superiority of one system over another.

At first sight it would seem that the two phases in a two-phase generator, being in quadrature with each other, would not be subjected to mutual induction. We must consider, however, that the two armatures of a two-phase machine, although displaced toward one another by ninety electrical degrees, and, so far as this displacement is concerned, being independent of one another—are electromagnetically connected with each other through the revolving field. We therefore find that the two phases in a two-phase machine are *not* independent of one another; that is, a load on one phase affects the potential on the other.

Theoretical considerations, as well as experience, have established the fact that a two-phase machine, so far as independence of phases is concerned, is not superior to a three-phase machine if the load on the latter is properly arranged.

The output of a two-phase generator is equal to the output of a three-phase generator. In other words, any two-phase generator may be wound as a three-phase generator without changing the rating, and *vice versa*.

The regulation of both two-phase and three-phase machines being equally good, according to the statements above made, it would seem that the three-phase system was preferable to the two-phase on account of requiring only three wires instead of four, leaving out of consideration the two-phase three-wire system. There is, however, a very interesting fact which should be observed, namely, a three-phase generator on which the load is connected between the outside wires is greatly inferior to a two-phase so far as regulation is concerned. Only, if the neutral connection of the three-phase generator is made use of, and if the load is put on between the neutral and the outside wires, the regulation in the three-phase machine is, in all respects, equal to that of the two-phase machine. But it must be observed that the three-phase machine requires, under these conditions, four wires, as in the case of the two-phase machine.

Summing up the pros and cons, Mr. Behrend considers that there is comparatively little choice between the two-phase and the three-phase systems, but there are certain slight advantages in favor of the three-phase system. If 75 per cent. of the load is a lighting load and 25 per cent. is a load that requires little attention to regulation, as, for instance, an arc-light load having its own regulator or a motor load, a three-phase generator has the further advantage that it can be operated as a single-phase machine, the lighting load being connected between two outside wires. In this case, the lighting load can be very easily regulated, while no attention need be paid to arc-light or motor load, as that is supposed to take care of itself.

WATT-METER IMPROVEMENT.

Under the title "What Improvement is Desired in Meters," papers were presented by Messrs. Robert Ferris and Clifford A. White. Mr. Ferris offered the following suggestions:—A universal meter in size and style; a backboard for meters, of a standard pattern, which could be adapted to meters of any make on the market; a registering dial that would read directly in dollars and cents, or if not that, then the adoption as a standard of direct reading dials and a simple tell-tale hand on clock for calibrating purposes; a meter that would take the place of the combination of watt and discount meters, having the effect of registering at different rates of speed, which would be governed by the load that was passing. To illustrate, assume a 100-volt wattmeter of 25-ampere capacity, which instead of showing a straight line from five per cent. of its capacity to full load, the meter speed would represent at full load accurate registering, and as the load dropped the proportional rate of registering would be a certain per cent. slow or fast.

If it were wanted to increase the hours of lighting on a twenty-four-hour service, the first method would apply; and in the stations where only night service is given and it is wanted to increase the quantity of lighting for short hours, the latter would apply. Of course the reading would not give the actual watt-hours, but it would be sufficient to call them units, which would be charged for at a uniform rate.

Speaking from the standpoint of a cashier of a central station, Mr. White said that anything that concerns the public should be as simple as possible. Therefore the meter dial should read direct in kw-hours, thereby eliminating any constants; the use of watt-hours shauld be abandoned, for by adopting the rule of reading in every case the figures the hand has passed on the unit dial, the

error in reading would never amount to more than 10 cents to the customer, and the total sales of the company would never be affected at all. A direct-reading dial should be designed to replace those requiring a constant, for it is next to impossible to make the customer understand the meaning of the latter. Testing should be done at the dial and not at the disk.

BEST METHOD OF CARING FOR METER COMPLAINTS.

With this title Mr. Irvin Butterworth presented a paper giving an account of a system adopted by the Denver Gas & Electric Company. This company has in operation a very complete system for receiving, recording and attending to complaints and requests received from its customers, which is regarded as one of the most important "bureau" of the office. It is in personal charge of what is called the "order clerk," whose sole duty it is to receive complaints and requests from customers and have them promptly and satisfactorily attended to. All complaints received personally or by mail are referred at once to the order clerk, who enters them on a large book so ruled as to show the reference number of the complaint and date and hour of its receipt, the name and address of the complainant, character of complaint, the name of employe sent to remedy it, the time of sending him, the time the complaint is reported as remedied, and the work that has been done. An order is then immediately filled out and turned over to the shop force for prompt attention; in urgent cases the shop is telephoned a confirming order following.

When the workman has attended to and remedied the complaint, and while he is still at the premises of the complainant, he fills out the remaining blanks on the order, showing the cause of the trouble, his method of remedying same, the date and his own name, and secures the signature, at the bottom of the order, of the complainant, or of a responsible member of his family, certifying that satisfactory attention has been given. The order is then returned to the order clerk, who enters the facts on his record book, above described. He then fills out and mails to the complainant a return postal card, worded as follows: "On————————, 1902, you reported..... Kindly fill out this return postal card stating whether the matter has been attended to to your entire satisfaction. Your prompt reply will be greatly appreciated. Very truly yours, The Denver Gas & Electric Co." The reference number is put on each of these cards before sending them out, in order that responses not signed may be identified, and those that are returned are checked off on the record book.

Of course many of the cards are not returned, but many of them are; and most of these report the trouble to have been satisfactorily remedied, many of them expressing thanks and appreciation. Occasionally one comes back with the statement that the trouble still exists or has not been satisfactorily attended to. In such cases a second order is made out and sent to the shop for immediate attention, with proper caution to the workman taking the order. The returned postal card is then attached to the original order, and after the second order comes back with the notation that the trouble has been remedied, the workman that attended to the original one is called upon by the order clerk to explain his failure to have properly remedied the trouble. Occasionally such derelict workman is brought before the manager and properly disciplined for his remissness. In this way each man knows that his work is under the review of the management, and a high degree of efficiency on the part of the workman has thus been developed. It is, of course, the duty of the record clerk to see that a report is turned in within a reasonable time on every order that is sent out for attention.

ACCOUNTING.

Two subjects relating to accounting were presented before the convention, one being "What Changes Should be Made in the Plan of Uniform Accounting?" by Mr. J. P. Crowley, and the other "Are Loose-Leaf Ledgers Desirable for Electric Companies?" to which Messrs. G. E. Tripp, H. H. Fairbanks, George W. Davenport and Charles R. Price contributed.

Mr. Crowley's paper consisted of comments on the "Plan of Uniform Accounting" submitted at the last convention. He considered that a more detailed classification should be made for the larger companies, and questioned the wisdom of the idea of harmonizing the system with the system adopted for street railway accounting, suggesting that in view of the tendency of consolidating electric and gas companies, it would be more advisable to produce a similarity with respect to the latter. The "Plan" is then criticised in detail and numerous suggestions are made as to changes and additions.

Mr. G. E. Tripp offered a number of objections to the use of a loose-leaf general ledger, and advocated the use of three different ledgers, namely, customers' ledger, general ledger and construction ledger. The loose-leaf customers' ledger would not be of any use in this system, as a new one is opened each year. It would not be required for a general ledger, for there will never be any dead accounts in such a book. The only advantage then of a loose-leaf ledger for the general ledger would be that of never having a break in an account, but by limiting the number and names of accounts the book is divided quite accurately, and the chance of a break small. As to the construction ledger, this is merely a memorandum book containing certain details as to charges to construction. Each account is closed as it is finished, and the dead accounts are of as much value for information as the live ones. Therefore there is no reason to eliminate the dead accounts.

Mr. H. H. Fairbanks explained the card system of accounting used by his company, giving reproductions of some of the forms of cards. The cards are kept in boxes and drawers which are fitted to the safe. It is stated that the card ledger can be posted quicker than a book, and that in general the system involves a saving of an immense amount of labor, and in practice is entirely satisfactory.

Mr. George W. Davenport said he did not believe in any form of accounting book, and gave a brief account of a card system used by a company having 2,500 customers.

Mr. Charles R. Price described a loose-leaf ledger system employed by a company having 4,500 gas and 1,000 or more electric customers. He said the Cambridge (Mass.) Gas Light Company had adopted a card ledger system which is giving complete satisfaction, an addressograph being used for writing up. While Mr. Price's company has not appreciated the advantages of a loose-leaf ledger to the extent of adopting it, it has devised a loose-leaf sales journal, which is found to facilitate getting out the monthly work in a way much appreciated by the bookkeepers. These are printed forms of uniform size, on different colored sheets for the different departments, showing the usual material and labor charged on jobs for wiring, piping, or shop accounts, fixtures, etc. They are usually filled in by the workmen as to items, price filled in by the foreman, and when numbered and bound in ready-made covers, form an original day book. Each sheet has all the information regarding any particular job, and is good evidence if a legal question arises. The last sheets of each month have a recapitulation of the total work under each heading for the month, and are posted into the sales ledger, from which a simple journal entry carries the monthly work into what is called the "Corporation Set." All bills are made from the journal sheets, so that the work is transcribed but once in the office, and with from three hundred to six hundred bills per month, of varying lengths, this is a very considerable item of labor saved. In conclusion, Mr. Price said that he does not at present see any advantages over the above system in a change to a loose-leaf method of keeping the acounts of his company.

PROTECTION OF LONG-DISTANCE TRANSMISSION LINES.

This subject was discussed in papers presented by Messrs. Charles H. Baker, L. Denis, P. N. Nunn, Henry J. Gille, P. M. Lincoln. The system with which Mr. Baker is connected transmits from Snoqualmie, at 30,000 volts, by two circuits each to Seattle, and two circuits each to Tacoma. The lines travel mostly through a densely timbered region, which, when cleared, is sowed with white clover, thus producing a fine turf, which removes the danger of running fire in the dry summer months.

The Seattle and Tacoma circuits are parallel to each other for twenty miles, and at the twenty-mile point they are interchangeable through a plugboard. It is the purpose later on to put a plugboard at one or two intermediate points, in order to be able further to interchange the circuits. By means of such boards if there is a break on any circuit it can be located on a parallel short division, and the circuit in trouble can be cut out and repaired. The wires are spaced thirty inches apart in the triangle, and it is the practice to repair a circuit in trouble while the current is running on the other circuit on the same set of poles. About every fifth pole has a spare cross-arm tacked upon it, and every half-mile there is a spare pole resting on skids, so that when there is trouble the patrolmen know where to go for relief material. A telephone booth is located every three miles along the transmission. The length of the section in charge of each patrolman varies, but in general one man has about twenty-one miles in charge, and patrols it twice a

week. Owing to the manner in which the Snoqualmie line is built, and to rigid inspection, all troubles have been eliminated due to falling timbers, running fires, or windstorms; in fact, the troubles have narrowed down entirely to those due to interference by malicious persons or boys throwing wires over the transmission lines. A law has been enacted making any such interference a penitentiary offense.

As soon as a short-circuit occurs the lines are tested out immediately to find out in what section the trouble lies. The trouble is invariably on one section only, so that the entire load is immediately placed on the other circuit pending the removal of the trouble. As soon as the trouble is located on a division, the troublemen from each end of the division start toward each other in great haste to reach the point. There are lightning arresters on the main generating circuits at each of the sub-stations. There is, however, very little lightning in that locality, and the arresters have only once in three years been called to duty, and on that occasion worked to perfection. All circuits are fused at sub-stations for 100 per cent. overload. Mr. Baker suggests that it is better to have the apex of the wire triangle located below the base for the reason that anything thrown across the lines would be less likely with such an arrangement to cross two wires; and he considers that 36 inches would be better spacing than 30 inches. He suggests that insulators should receive a brown glaze instead of white, as they will thus present a poorer target for anyone aiming at them. The petticoats of many insulators have been broken, but the wire almost invariably remains on the core, which would not be the case if glass insulators were used. He also suggests that the telephone system be maintained upon a separate set of poles, as trouble on transmission lines is very sure to put the telephone out of circuit.

The Quebec-Jacques Cartier Electric Company has, Mr. Denis said, thus far had little experience with lightning trouble. The transmission line consists of two three-phase 23,000-volt lines, some eighteen miles in length, and is protected at both terminals where the wires enter buildings with lightning arresters, which are the only protection used against lightning. Although they spark occasionally, no trouble has been experienced more than a partial short-circuit from the discharge. There is more trouble from gradual discharge and from induced discharge that takes effect on the low-tension side of station transformers. On one occasion one of these charges caused quite an amount of damage on the 2,000-volt switchboard, but in this, as in similar cases, apparently no damage was done to station transformers. Mr. Denis adds that the locality has quite a reputation for the severity of its lightning storms.

Mr. P. N. Nunn said that on several parts of his lines located in Colorado, Utah and Montana, each operated at voltages ranging from 40,000 to 60,000, Wurts non-arcing arresters are used, and there has never been a serious disaster caused by lightning or by violent oscillations caused by opening and closing of long power lines of large capacity and at a very high potential. There have been, however, numerous small annoyances from the above causes, and for this reason it is not considered that the present lightning protection is entirely satisfactory, and experiments have been made to improve it, including shunted and series resistances and fewer paths to ground.

The St. Croix Power Company, with which Mr. Gille is connected, is operating 25,000-volt transmission lines approximately thirty miles long, from Apple River Falls, Wisconsin, to St. Paul, Minnesota. During electrical storms the line is almost always affected in some way, sometimes very slightly, and sometimes causing the system to be shut down entirely. When the storm is severe, the discharge is usually on one leg of the arrester. The discharge affects the generators at the power house practically the same as does a heavy short-circuit, and there seems to be a strong tendency of the generators to motorize and always slow down, in some cases coming practically to a standstill. In several cases lightning has apparently disregarded the choke coil and lightning arresters and damaged the transformers. At the sub-station the rotary converters slow down, but apparently remain in step until the fields practically become dead, which occurs in about ten seconds. When the generators begin to pick up at the power house the rotaries also come up, with considerable flashing at the brushes, but sometimes with their polarity reversed, in which case it is necessary to shut them down and change their polarity. The alternating-current system is not so easily affected by lightning as is the direct-current system. If the electrical disturbance is light, the lamps in the city merely wink; when, however, the disturbances are very severe, it is difficult to keep the converters in service. There is evidence on a great many poles on the transmission of discharges which have jumped from the wire to the poles, but there have been no insulators broken through lightning discharges. The lightning arresters and static arresters are so adjusted that they discharge constantly, the discharge being very light and visible only on two or three gaps next to the line wire. The arresters at one end of the line were very badly damaged in a storm last summer, when the discharge apparently jumped from the line to the ground, arcing across the cylinders without regard to the resistances, forming a straight path to the ground. The trouble where no synchronous apparatus is used is not serious, but all the companies of which Mr. Gille has knowledge, that are operating synchronous apparatus, have considerable trouble during electrical storms.

Mr. P. M. Lincoln gave his experience in connection with the Niagara plant. So far as construction of apparatus is concerned, the Niagara-Buffalo line has been peculiarly fortunate during the five and a half years of its operation. Practically the only apparatus that has been destroyed by lightning have been lightning arresters, the only exceptions being a 500-kw transformer, an ammeter transformer and a few ground detectors. Experience has shown that it is absolutely necessary to limit by means of resistance the dynamo current which flows on the discharge of an arrester; for, no matter what the number of gaps through which the discharge takes place, the arc, once started, seems to be maintained unless the dynamo current is limited. The most satisfactory lightning device is that now used on the lines, the Westinghouse "Low Equivalent" lightning arrester, the gaps of which have an ohmic resistance in series with them and another larger resistance in shunt to a portion of the gaps. In general, this arrangement gives the line-discharging effect of the small series resistance, and the current interrupting effect of the combined shunt and series resistances. Experience has led to the adoption of fuses on the discharge circuit, so that in the case of a short-circuit taking place in the arresters, both lines and arresters are protected. In all lightning arresters choke coils are put in the line, and the discharge circuits attached on the line outside of the choke coils.

As to how frequently the lines are affected by lightning that the devices have failed to arrest, those occasions when the arrester conducts off the flash, but becomes short-circuited, can hardly be called failures to arrest. It is possible—and perhaps even probable—that other apparatus might have been destroyed had not the flash been taken care of by the arrester. In most of the failures to arrest, as observed on the Niagara-Buffalo line, the lightning has caused short-circuits somewhere along the overhead line, sometimes with a simultaneous discharge across the gaps of the arrester and sometimes with no sign of such discharge. Observations would indicate that the voltage necessary to jump over a wet insulator does not differ greatly from that required to jump across the gaps of the lightning arrester. In case such a short-circuit is once established anywhere along the line, it almost always continues until the current is pulled off the lines, in spite of the fact that the distance between the conductors is 36 inches. Most of the lightning interruptions are of this nature. No permanent damage is done. All that is necessary is to take off the current for an instant; supply of power can be resumed immediately. An examination of the records for the past three summers—those of 1899, 1900 and 1901—shows that during that time eighteen interruptions occurred due to lightning, five of which occurred within a space of about three hours, during a storm of unprecedented severity. The average duration of the interruptions has been about four minutes. In view of the prevalence of lightning on the Niagara frontier, Mr. Lincoln considers this record a very good one.

The New President.

Mr. Louis A. Ferguson was born at Dorchester, Mass., Aug. 19, 1867. He was educated in the Boston public schools, graduating from the Dorchester High School in 1884. Entering the Massachusetts Institute of Technology, he took the full four years' course, graduating in 1888, with the degree of bachelor of science in the department of electrical engineering. In August of the same year he joined the staff of the Chicago Edison Company, whose rapid growth furnished an excellent opportunity for his ability. He was soon made electrician of the underground department, a position he filled until the beginning of 1889, when he became assistant electrical

engineer of the construction department. In 1890 he was appointed electrical engineer of the company.

In 1893 Mr. Ferguson's duties as electrical engineer were increased by the placing in his hands of the contracting department of the company, and in June, 1897, he was appointed general superintendent of the Chicago Edison Company, in charge of the operating and electrical engineering departments, together with the contracting department. This meant virtually the technical oversight of all the central station work within Chicago city limits, as the Edison Company had become master of the situation; soon after, strengthening its hold on the territory by the formation of the Commonwealth Electric Company, which consolidated the properties in the larger field outside the denser sections of the city. In 1898 Mr. Ferguson became general superintendent of the Commonwealth Company also.

Mr. Ferguson was the first one to suggest, in this country at least,

L. A. FERGUSON, PRESIDENT NATIONAL ELECTRIC LIGHT ASSOCIATION.

a station generating three-phase alternating current with transmission lines to sub-stations operating "rotaries" converting from alternating to direct current for general distribution. The first apparatus built for this purpose in connection with lighting stations is now in operation in Chicago. The Chicago Edison Company now has eight substations using rotary converters and motor generators, and at the present time is building the largest double-current generator known, the nominal capacity being 2,500 kilowatts, and the ultimate capacity 3,200 kilowatts, generating direct current at 300 volts, and alternating current at 180 volts, the machine weighing 320,000 lbs.

Mr. Ferguson, in 1895, was appointed on the staff of lecturers of the University of Wisconsin. In 1898 he was elected president of the Northwestern Alumni Association of the Massachusetts Institute of Technology, serving one year. He was elected vice-president of the National Electric Light Association in 1900 and 1901, and has read papers before that body as well as before the Edison Association, of which body he was elected president last year. Mr. Ferguson has also contributed to the technical press at various times, and has made several trips to Europe to investigate electrical development there.

Convention Exhibits and Notes.

THE DAILY BULLETIN issued by the Bullock Company, under the editorship of Mr. Bolles, was a great boon, and, coming out at least once a day, was much in demand by everybody. Each person in attendance, on signing a numbered card, received a numbered button, and the name, number, etc., were printed in the Bulletin in full, proving very handy for reference. The Bulletin, which was narrow enough to fit a vest pocket, contained also an excellent map of Cincinnati, the programme and other matter.

AMERICAN CIRCULAR LOOM CO. was represented by H. B. Kirkland and Thos. G. Grier.

R. B. COREY represented the various lines he carries.

J. W. MCDOWELL, New York, represented the Manhattan Electrical Supply Co.

J. H. DALE represented the Dale Company, New York City.

THEO. D. MOULTEN represented the Shedd oscillating fan, New York, and had some of his "Dick Swiveller" fans in most grateful operation.

E. J. MCALLISTER, Newark, N. J., representing the Electric Motor & Equipment Co., showed its photometer and its sign commutating devices.

MR. C. E. CORRIGAN and J. S. Monroe represented the Osburn Flexible Conduit Company, and had a small exhibit board of samples.

F. C. COLWELL represented the General Incandescent Arc Light Co. Engineer Hallberg, of the lamp department, was also in attendance.

JAMES JONES, JR., was present for J. Jones & Son, electrical supplies, New York City.

J. VAUGHAN represented J. Buchanan & Co., Philadelphia.

THE PHOENIX GLASS CO. was represented by E. H. Peck, New York.

R. EDWARDS, JR., and E. W. Rackafellow, of New York, represented the Western Electric Co.

C. J. HARRINGTON, New York, represented the Scranton Fire Brick Clay & Conduit Co.

W. S. ECKERT, New York, was on hand for the National Conduit & Cable Co.

F. J. ANDERSON, of New York, represented the Stanley Instrument Co., of Pittsfield, Mass.

THE GOULD STORAGE BATTERY CO., New York, was represented by Chas. M. Gould, F. P. Huntley, W. W. Donaldson and A. S. Hubbard.

MR. H. B. MOORE represented the Chase-Shawmut Co., of Boston and interested many delegates in the new indicating enclosed fuse which that company is just putting on the market.

MR. S. B. CONDIT, JR., of S. B. Condit, Jr., & Co., Boston, arrived Tuesday morning. The attention of central station men throughout the country is being attracted to the Elden oil circuit breakers and switches, which this firm manufactures, and the large switchboards which it is equipping with this apparatus; and Mr. Condit had many inquiries to answer.

MR. C. F. MUNDER, of the Munder Electric Co., Springfield, Mass., was an early arrival at the convention. He is a familiar figure at electric light conventions, and he and his incandescent lamps became better known than ever before.

SPRAGUE ELECTRIC COMPANY, of New York City, was represented by Mr. Alex. Henderson, of the conduit department, who occupied one of the parlors and had on view one of the most comprehensive and illustrative exhibits of steel armored conduits that it is possible to imagine. The range of sizes included everything from signal, bell and telephone work up to the largest runs of light and power circuit, and the flexibility and adaptability of the system were admirably shown, and attracted a large amount of attention.

AMERICAN ELECTRICAL MFG. CO., of Philadelphia, was represented by Mr. J. Allen Heany, who had on view in one of the parlors three of his new and interesting enclosed arc lamps, two of 110 cp, taking 3½ amp., and one 220, taking 2 amp., all direct current. These lamps, which were recently described and illustrated in the pages of ELECTRICAL WORLD AND ENGINEER, are of most simple construction. The lamp body or frame is built up of three tubes, held at the top by a casting and at the base by a plain stamping. The small solenoid coil is held and adjustably supported by the tubes, and provision is made which allows the coil to be slid up and down so as to adjust the lamp to the amount of current that is to be consumed, without making any change in the resistance of the lamp. Within one of the tubes is another, carrying the upper carbon, and surrounding it is a combination solenoid core and clutch, composed of two semi-tubular members on pivots or hinges, and arranged to slide up and down on the carbon-containing tube. These hinged members have jaws to grip the upper carbon; and when the solenoid core is energized by the coil that surrounds it, they act like poles. Repulsion takes place, throwing the jaws inward, both to clutch the upper carbon and to lift it, establishing the arc; and when the carbon has to feed the clutch jaws let go, so that the carbon can slide down. The solenoid coil contains less than a pound of wire, and cannot be broken down. The total weight of the lamp is less than six pounds, and the length is less than 18 inches. The voltage at the arc may be regulated by cutting in and out the regulating resistance, but Mr. Heany stated that he preferred 75 to 80, as giving less blue or violet in the arc. The dash-pot is also a very simple mechanism, and the arrangements for holding the globes for carbon renewals, etc., are equally simple and ingenious.

THE WESTINGHOUSE ELECTRIC & MFG. CO. had a most interesting exhibit, which naturally and properly centered around the Nernst lamp. Vice-President Taylor was in charge of the Westinghouse forces, and Mr. Calvin W. Rice, the second vice-president of the Nernst Company, had charge of the lamp display, the room being

lit by a central cluster, and having a most elaborate exhibition of lamp parts, glowers, heaters, ballast, etc., for the four sizes of 88, 176, 264 and 528 watts. There was also an apparatus to illustrate the ease with which fabrics could be used or shown under its rays without the apparent change of hue due to the use of other illuminants. The exhibit contained also a variety of instruments, including glass case integrating wattmeters, single phase, 7,200 alternations, 10 amp., 100 volts, and iron case, 1,600 alt., 5 amp., 100 volts; voltmeters, 7,200 alt., 150 volts; ammeter for alternating circuits, 800 amp.; power factorometers; synchronouscope; automatic circuit breakers, 1,500 amp., 750 volts, for direct and alternating circuits; small transformers for lighting, of the shell type. In addition to Messrs. F. H. Taylor and C. W. Rice as named above, the Westinghouse interests were represented by Messrs. W. M. Probasco, C. B. Humphrey, W. S. Rugg, J. W. Shantz, H. C. March, R. U. C. Barnes, Alex. Wurts, W. R. Pinckard, C. S. Powell, W. H. Whiteside, A. Goodby, H. D. Shute, G. B. Griffin, C. F. Scott, C. Townley, E. Gawger, F. Hodkinson, T. H. B. Whiffie and G. A. Nellis, the two latter also being in charge of Sawyer-Man Electric Co.'s interests, with Mr. C. A. Ross.

GENERAL ELECTRIC Co. occupied a parlor, but made no exhibit, contenting itself with the distribution of literature, and with the display of a sign in miniature lamps outside its headquarters. It was represented by Messrs. J. R. Lovejoy, manager of the lighting department; A. D. Page, manager incandescent lamp sales; J. B. Pevear, manager Cincinnati office; C. B. Davis, manager Boston office; Irving Hale, manager Denver office; A. L. Rohrer, E. E. Gilbert, P. D. Wagoner, H. W. Hilman and F. Vaughan, of the Schenectady works; E. H. Mullin, of the New York office; R. Fleming and F. B. Cox, of Lynn, and others.

PROF. W. E. GOLDSBOROUGH, director of the department of electrical exhibits at the St. Louis Fair, was in attendance to meet the manufacturers and delegates and to foster interest in the subject of the fair for 1904.

LIEUT. E. J. SPENCER, of St. Louis, was present in behalf of the interests of the Safety Insulated Wire & Cable Company, which he represents in the West.

MR. LUTHER STIERINGER, although not in the best of health, braved the steamy rigors of the Cincinnati climate to attend the convention and keep in touch with the latest developments in the art.

THE CHAS. E. DUSTIN Co., of New York City, was represented by Mr. W. S. Barstow, its consulting engineer. This well-known electric light manager has a number of new and old plants in hand for treatment on modern lines.

ROSSITER, MACGOVERN Co., of New York, was quite adequately represented in the person of Mr. Frank MacGovern and Mr. James A. Pierce, western representative.

THE BANNER ELECTRIC Co., Youngstown, Ohio, was represented by Messrs. N. L. Norris, J. E. Hart, F. C. Kirchner and R. T. Hamilton. They exhibited a complete assortment of Banner lamps of various types and voltages. Prominent among these were their new 220-volt lamp and their standard 16-candle-power lamp. On a very attractive showboard were displayed in operation a large number of styles of ornamental and sign lamps. The Banner Co. make their own filaments. A feature of their exhibit which attracted a great deal of attention was a case in which were shown the various steps in incandescent lamp manufacture, from the cellulose compound from which the filament is made to the completed lamp. Dice boxes made of celluloid, with a transparent top and containing a set of dice, were distributed as souvenirs, as were also "Banner" buttons. An unusually attractive and elaborate folder, prepared expressly for the occasion, was handed to all visitors. It was entitled "The Right of Way."

THE ELECTRIC STORAGE BATTERY Co., of Philadelphia, was represented at the convention by Mr. Chas. Blizard, manager of the sales department; Mr. E. Vail Stebbins, manager of the Cleveland office, and Mr. G. H. Atkin, manager of the Chicago office. The large battery of "chloride accumulators" on the system of the Cincinnati Gas & Elect. Co. was visited with much interest by the delegates. Another battery of considerable interest is a small signal set at the East Norwood station of the B. & O. R. R. This is one of the early installations of "chloride accumulators," having been in service continuously for over eight years.

THE HELIOS-UPTON Co., Philadelphia, was represented by Mr. King Upton and by Mr. C. D. Meyers, of Philadelphia, and Mr. Robert Gregg, of the Chicago office. They exhibited in operation their series alternating lamp and their high-economy Continental lamp. Bulletins describing these lamps were distributed.

MR. JAMES I. AYER, manager of the Electric Heating Corporation (department of the Simplex Electric Co.) of Cambridgeport, Mass., was, as usual, in active attendance and very cordially welcomed by all old friends as well as by many new. Aside from his business interests, Mr. Ayer has done a lot of valuable work for the Association and he is one of the past presidents who retains a lively concern in the welfare of the Association. He participated in all that was going on that had reference to the advance of the art.

THE NERNST LAMP Co., whose exhibit has already been referred to in connection with the Westinghouse exhibit, not only made one of the most original and interesting displays under the direction of Vice-president Rice, but distributed some excellent literature One neat and tasteful pamphlet, with a pretty cover in green and silver, dealt with the subject broadly and in detail, not only giving the history of the lamp, but enumerating a number of patents on it and then dealing with practical questions. It illustrated the lamp collectively and in parts and explained the *modus operandi;* while there were also a number of cuts devoted to manufacturing and commercial details. The statement was also made, of no slight significance, that within a few months after the close of the Pan-American Exposition at Buffalo, there were over 2,500 Nernst lamps operating under all conditions of service, representing a total of not less than 300,000 cp, at which time also the company was making over one thousand 50 cp glowers per day.

ELECTRICAL WORLD AND ENGINEER occupied the suite 330-4 and was represented by Pres. J. M. Wakeman; T. C. Martin and J. R. Cravath, editors; G. W. Elliott, New York office; J. V. S. Church, Chicago office; E. T. Walker, Boston office; C. Walker, Philadelphia office.

VISITORS FROM ENGLAND. A very active interest was taken in the proceedings of the Association by two English engineers who had but just arrived in the country on a tour of inspection. One of these gentlemen is Mr. L. Andrews, the electrical engineer of the Hastings corporation, and the other is Mr. C. T. Thompson, who until recently was assistant works manager with the Brush Electrical Engineering Co., of England. Reaching America as the convention began they immediately "made tracks" for Cincinnati, and found a great deal to interest them in the proceedings. They will visit several factories and stations before returning home.

PASS & SEYMOUR, Syracuse, N. Y., were represented by C. M. Crofoot (Cincinnati) and F. M. Hawkins (N. Y.).

CROUSE-HINDS ELEC. Co. (Syracuse, N. Y.) was represented by Mr. Hinds and C. M. Crofoot of Cincinnati.

HART & HEGEMAN MFG. Co., Hartford, Conn., was represented by R. B. Corey.

AMERICAN DISTRICT STEAM Co., Lockport, N. Y., was represented by H. C. Eddy of Chicago.

AMERICAN ELECTRICAL WORKS, Providence, R. I. was represented by F. E. Donohue of Chicago.

THE PETTINGILL-ANDREWS Co., Boston, through its representative, Mr. W. J. Keenan, distributed leather-bound copies of the Underwriters' Rules—a souvenir that made a decided hit.

THE MARSHALL-SANDERS Co., Boston, was represented by Mr. C. A. Sanders.

THE LOMBARD GOVERNOR Co., Boston, was represented by its manager, Mr. Allan V. Garratt, who has recently returned from some important work out west.

MR. J. C. SHAINWALD was present in behalf of the interests of the Standard Paint Co., of New York and the rest of the world. Mr. H. W. Benedict was also in evidence.

THE TRIUMPH ELECTRIC Co., of Cincinnati, whose motors and dynamos are so well known throughout the west, as well as other sections of the country, did not make an exhibit at the hotel, but was represented by Messrs. J. C. Hobart, manager, W. H. Jacob, manager of sales, C. S. Reno, chief electrician, and D. D. Gill. They gave away a neat souvenir in the shape of a tape measure. Among recent large motor equipments have been those for the French piano factory and the great Globe-Wernicke bookcase shops.

NATIONAL BUREAU OF STANDARDS was represented by Mr. Frank A. Wolff, Jr., of Washington, D. C., who had much to discuss with delegates and members in regard to the work to be done in the lighting field.

FORT WAYNE ELECTRIC WORKS occupied a parlor on the long hall, and were represented by F. S. Hunting, general sales manager, A.

A. Serva, assistant sales manager, T. L. Sturgeon, Indiana agent, T. J. Ryan and G. B. Edgar, Cincinnati, J. E. Hall, Pittsburg, W. S. Goll and W. C. Knight, of Chicago. There were exhibited arc lamps of all descriptions, type K meters, motor starting panels, instruments, and the revolving fan motor with cord suspension. Several of these fans were distributed around the hotel and gave a grateful breeze.

THOSE WHO EXHIBITED fan motors during the roasting, or rather boiling week, were rewarded by the hearty gratitude and appreciation of every delegate. The breeze shed by the Shedd was voted "it."

THE CONSUMERS' CARBON CO. was represented by Messrs. Edmund Dickey, general manager; M. M. Hayden, supt.; W. C. McGowan, selling agent for the South; A. J. Webb, eastern agent, and W. H. Schott, Chicago agent. The concern is making a full line of standard carbons and bid fair to win and retain a wide popularity for its product, if its reception at the convention was any indication.

NATIONAL CARBON CO. was represented by Mr. N. C. Cotabish, its well known sales manager, who, in view of the universal use of its product by central station men, deemed it hardly necessary to make an exhibit of points or brushes, etc.

MR. JAS. WOLFF was on hand in the interests of the New York Insulated Wire Co.

KUHLMAN ELEC. CO., of Elkhart, Ind., was represented by Mr. E. Kuhlman, who had a neat pamphlet which illustrated and described their transformers.

ADAMS-BAGNALL ELECTRIC CO. was represented by Mr. J. G. Pomeroy, in charge of western sales of its well known lamps, at Chicago.

MR. G. S. SEARING, of Chicago, was present on behalf of Peru Elec. Mfg. Co. and Hart & Hegeman Mfg. Co.

UNITED STATES CARBON CO., of Cleveland, was represented by Mr. B. P. Foster, general manager.

BRYAN-MARSH COMPANY had its well known incandescent lamps represented by C. D. Marsh, G. C. Keech.

TRIP TO BULLOCK WORKS. The Bullock Elec. Mfg. Co. had parlors at the hotel, but made their exhibit at their fine new works at Norwood, still in process of rapid and considerable extension. A special train ran out over the Baltimore & Ohio at 4 P. M., on Wednesday, and the convention having adjourned for the purpose of accepting the invitation to visit the shops, some four or five hundred delegates and guests availed themselves of this excellent opportunity to see one of the newest, largest and best electrical shops in the west. On arrival at the beautiful works, built in a light cream brick with stone trimmings, a photograph group of the visitors was taken and a brief, cordial welcome was extended by Pres. George Bullock. The visitors then filed through the buildings and were particularly struck with the main shop, 600 feet long, without a belt or shaft or wire in sight, but with motors in every direction on large and small machine tools, direct connected, short geared, etc., and doing their work with a facility and smoothness that justified all the claims that have been made for motors. Some very heavy work was in process, including generators up to 3,500 kw for the Cincinnati Gas & Elec. Co. Other parts of the works were visited in turn, and then a lunch was served in one of the buildings. Messrs. Lozier, Neave, Bolles, Behrend, Alexander, Collyer, and others assisted Pres. Bullock, and everyone voted the trip most enjoyable and a profitable use of the afternoon.

NATIONAL ELECTRIC IMPROVEMENT CO. made a splendid display of their "Elblight" system under the efficient direction of Mr. Russell Spaulding. There were no fewer than 2,000 lights shown outside the hotel and 2,000 within, fixed into the special twin cable by means of the well known sharp pin terminals or fastened similarly into the boards of insulating material specially designed for the Elblight work. The outside of the hotel had long streamers of lamps from roof to portico, with a crown at the top and a fine representation in the center of the badge of the Association. Inside the main hall or rotunda were long streamers of the cable with green and white lamps, from the dome to the side pillars, giving a most dazzling and graceful effect. In the meeting room there was a sign made up like the Association badge; in the long hall there was the American flag studded with lamps, and in the Elblight parlor there was a most notable collection of signs using the lamps and material. A dramatic test was made of the system by the storm that swept over Cincinnati on Tuesday morning, killing several people and doing a million dollars damage. The rain fell in torrents, the wind traveled 60 miles an hour. But outside the hotel only about ten lamps were broken, by their tips striking the stone walls. Inside the rain poured in a deluge through sudden leaks into the rotunda, over lamps and cables, but it "never phased them a bit," both lamps and cable standing up as to insulation, etc., and giving out their light serenely all through the pitchy darkness of the storm. It was a great and convincing demonstration.

AM. VITRIFIED CONDUIT CO. had an exhibit in the long hall of its conduit under the management of Mr. G. M. Gest. A huge manhole on the Cincinnati Gas & Electric Co.'s system, 11 feet by 11 by 11, was fitted up also as a reception room and delegates were invited thither to enjoy all the comforts of home, with a few of the restaurant and bar. The place, right under the center of the street, was fitted up as a parlor with rugs, draperies, fans, etc., and proved one of the most curious and attractive novelties of the whole convention.

HUBBARD & HALL CO., of Cincinnati, were well represented by Mr. W. A. Hall, who is agent for a great many well known electrical specialties as well as maker of others. The concern was also spoken for by Mr. G. H. Jones. A great many visitors made their way to the headquarters of the concern, where they made very much at home.

POST-GLOVER ELECTRIC CO., of Cincinnati, was represented by Messrs. S. Glover, G. Devon, F. D. Van Winkle, G. Knoff and others, and received friends at its spacious store.

CREAGHEAD ENGINEERING CO., of Cincinnati, were represented by Mr. T. L. Creaghead.

DEVERE ELECTRIC CO., of Cincinnati, who are just occupying a fine new store, were represented at the convention by Messrs. W. Stewart, W. H. Schepers and others.

THE "X. S." CAPACITY INDICATOR was shown in operation in the long hall by the Excess Indicator Company, of 7 Water Street, Boston, who are following up the work done by Mr. Wallis, of Woburn, with his "4-c" system. They showed the new model of the device for 1902 in operation, with the case removed; and its fireproof qualities, small current losses, ease of adjustment, etc., were all illustrated. The company were represented by Messrs. R. J. Patterson and G. K. Boutelle, who showed the indicator under test on the bank of lamps to all comers.

JOHN A. ROEBLING'S SONS CO. were well represented by Messrs. Bailey, F. Harrington and others.

MR. H. F. TATE, of Chicago, responded for the National Conduit & Cable Co.

LANE & BODLEY CO. invited the delegates visiting the Bullock works to note their fine new twentieth century cross compound, direct-connected engine being installed in the new power plant. They were represented at the convention by Messrs. G. H. T. Lane and W. S. Nourse.

THE STERLING ELEC. MFG. CO., Warren, O., were represented by Messrs. William Coale, Glenn C. Webster and J. W. McNair. They distributed copies of their recent booklet, "The Midnight Sun," as well as other literature descriptive of "The Sterling Special" lamp.

THE PITTSBURG ELECTRIC LAMP CO., Braddock, Pa., was represented by Mr. E. R. Morrow, of Pittsburg.

THE STANDARD UNDERGROUND CABLE CO., Pittsburg, was represented by J. R. Wiley, Chicago, T. E. Hughes, Philadelphia, and C. J. Marsh, New York. Their exhibit included samples showing paper and rubber insulated lead-covered underground cables for very high voltages. Among other literature which was distributed, was a booklet showing handsome illustrations of buildings in which their rubber covered wire was used. Engineers were invited to register their names and addresses to insure receiving a copy of the new edition of the hand book of useful information to be issued shortly. The book has proved so popular that the previous edition has been exhausted.

ROBERT KELLY, JR., of Newark, O., and M. J. Davies represented the Holophane Glass Co.

CHARLES G. WERTZ showed the exhibit of the Elliott & Hatch Book Typewriter Co.

W. V. SWEETON represented the American Push Button Telephone Co., New York.

MR. J. A. VAUGHAN, New York, represented J. F. Buchanan & Co., Philadelphia.

THE NEW YORK & OHIO CO., Warren, O., was represented by Mr. W. D. Packard on behalf of their lamps, transformers, etc.

MR. C. K. HILL, Pittsburg, was at the convention, meeting his many friends.

THE WARREN ELECTRIC & SPECIALTY CO., Warren, O., was represented at the convention by Messrs. E. W. Gillmer and E. E. Nash.

THE COLONIAL ELECTRIC CO. was represented by Mr. J. B. Estabrook, Ravenna, O.

GUTTMANN METERS. One of the exhibits attracting attention was the light and compact Guttmann recording wattmeter. It was exhibited by the Electrical Appliance Company, of Chicago, which was represented by Pres. W. W. Low and Mr. Millard, who have long since become familiar at the electric light conventions. The Sangamon Electric Company, manufacturer of meters, were represented by Mr. L. Guttman. The meter, with its aluminum cover, presents a handsome appearance, is remarkably small in size and simple in construction. The meters on exhibit were for 2 or 3-wire circuits and the latter for balanced or unbalanced loads. The internal construction was frequently examined and the workmanship favorably commented upon.

MR. GEO. B. DAVIS, manager of the Standard Chemical Co., Boston, was in attendance; Mr. Davis has been at several of the electric light conventions explaining the merits of his company's "Soaposo" for the cleaning of central station floors. He states that central stations are, as a class, the cleanest plants in the world.

GEN. INCANDESCENT ARC LIGHT CO. were not only represented by several thousand enclosed arc lights on the Cincinnati circuits, but by Messrs. Martin Insull, Hallberg and Colwell.

STANLEY ELEC. MFG. CO. Just at the entrance to the Assembly Hall was the S. K. C. system (Stanley Electric Mfg. Co.) exhibit, consisting in main of maps and photographs of the great transmission lines of California and displaying the coils and core of a 30-light S. K. C. oil transformer. The method of separately winding and insulating the sections of the coil in this type of transformer was nicely demonstrated by showing the sections of one half a coil before assembling. An interesting treatise in the form of a 16 page circular headed, "Recent Transformer Litigation" was distributed, occasioning considerable comment. Copies of Dr. Perrine's paper before the New York Electrical Society on "Power Plants of the Pacific Coast" were also dispensed. This is a beautifully printed and illustrated and highly interesting piece of literature. A Falk photograph of Lord Kelvin, autographed "Kelvin, New York, May 6th, 1902," provided a very interesting addition to the S. K. C. corner. The photograph itself shows Lord Kelvin perusing the March *Review of Reviews* article on "Long Distance Transmission in California," the illustrations and part of a page of text being readily recognized. This page, cut from a copy of the magazine, as well as the cover of the magazine were framed with the portrait, making an exceedingly interesting combination. The Stanley Electric Mfg. Co. were represented by Mr. Bergenthal, of the Chicago office, and Mr. Bibber, of the New York office. Dr. Perrine, as noted elsewhere, presented a paper, "Protection to Long Distance Transmission Lines." Mr. Ray D. Lillibridge, advertising manager of the Stanley and other concerns, arranged the exhibit and was also on the ground during the convention.

MR. ALEX. HENDERSON, in slight acknowledgment of his valuable services as acting Master of Transportation and especially in connection with the convention train leaving New York on Sunday morning, was presented at the Bullock works, on the occasion of the visit there, by a number of the delegates, with a handsome, jewelled cigar cutter, marked "Cincinnati, 1902." It was greatly appreciated by the recipient, who immediately proceeded to try it on one of the choice Bullock Havanas. The compliment to Mr. Henderson was well earned.

JOHN S. NOWOTNY ELEC. CO., of Cincinnati, was represented by the gentleman of that name at the head of the concern.

ROBBINS & MYERS CO., of Springfield, O., were represented in regard to their fans, etc., by Messrs. W. W. Munroe and R. P. Thompson.